THE

AMERICAN NATURALIST

VOL. XXIX. June, 1895. 342

IS DAEMONELIX A BURROW?[1]

A REPLY TO DR. THEODOR FUCHS.

BY ERWIN HINCKLEY BARBOUR.

Dr. Theodor Fuchs, criticises at considerable length the nature of Daemonelix as described by the author, in the University Studies, of the University of Nebraska, Vol. I, No. 4, July, 1892, under the title, 'Notes on a New Order of Gigantic Fossils.'

When the criticism first appeared it seemed so fraught with errors that they were counted its own best rebuttal, and no attempt to frame a reply was thought of. However, the author has several times of late been reminded that these errors might pass muster and become fixed in the minds of those, at least, who place too implicit reliance in authority. Therefore in all justice to himself and to those who have been entirely misguided and misinformed the author thinks it better, perhaps, to correct certain errors and inaccuracies.

After carefully describing the burrows of the supposed Miocene gopher, citing as important proof the rodent found inside of one specimen of Daemonelix, and after quoting Gesner on the 'Habit of the Pouched Rat' Geomys pineti, of Georgia, he writes:

[1] In Annalen k. k. Naturhistorichen Hofmuseums, Wein, 1893, Pages 91 to 94.

"I think we have before us all the essential elements of Daemonelix, and that accordingly we are justified in viewing these strange fossils as nothing else in reality than the underground homes of Miocene rodents, apparently of the family Geomyidæ.[2] Thereby it is very easy to explain why these spirals are found invariably in upright positions; why they are never prostrate, bent or broken. Also why, in spite of their massive size, no organic substance is present. But further the nature of the deposit in which these strange bodies occur sheds unexpected light.

"According to the representations and drawings of the author, these Daemonelix are in the Miocene deposits of the Bad Lands, and are not confined to one stratum but they occur in the entire mass of these layers, and one very frequently sees sides of the hills more than one hundred feet high, from bottom to top, studded with the screws, but especially with the rootstalk which projects everywhere on the sides of the hills.

"Under such circumstances these Miocene deposits can not possibly be those of an inland sea, but we must regard them as essentially continental formations for the most part of subäerial origin; the same as our Loess, as the pampas formation, and many similar ones.

"The assertion of the author, that the rock in which Daemonelix occurs is a very homogeneous fine sandstone, agrees very well with the above conception."[3]

[2] The same conception of Daemonelix could have been found in the American Naturalist for June, 1893 as proposed by Dr. E. D. Cope.

[3] Ich glaube, dass wir heir alle wesentlichen Elemente eines Daimonelix vor uns haben, und dass wir demnach berechtigt sind, in diesen sonderbaren Fossilien wirklich nichts Anderes als die unterirdischen Wohnungen miocäner Nagethiere, warscheinlich aus der Verwandtschaft von Geomys zu sehen.

Hiedurch erklärt sich ganz einfach, warum man diese Schraubenköper ausnahmslos in verticaler aufrechter Stellung findet, warum sie niemals umgefallen, umgebogen oder zerbrochen erscheinen, ebenso auch warum trotz ihres massigen Baues keine organische Substanz in ihnen vorhanden ist.

Aber auch auf die Natur der Ablagerungen, in welchen diese sonderbaren Körper auftreten, wird hierdurch ein unerwartetes Licht geworfen.

Nach der Darstellung und den Zeichnungen des Verfassers sind diese Daimonelix in den Miocänbildungen der Bad Lands durchaus nicht auf eine bestimmte Schicht beschränkt, sondern sie kommen durch die ganze Masse dieser Ablager-

The foregoing argument when summed up reads about as follows: Daemonelix is a burrow (false premise); burrows can not exist in water; therefore the Miocene of the Bad Lands are wind deposits (false conclusion). No valid argument can be based on the assumption of the point to be established and proved.

A premise, as the name signifies, is something antecedently established or proved, therefore the argument is based on the false premise that Daemonelix is a burrow, which is not an established fact, but is the fact which he is to establish. If the premise is false, so is the conclusion, and we find it remarkably exemplified in this case. The startling and extraordinary conclusion is, that the well-known region of the Miocene Bad Lands is a wind deposit, and not a water deposit, as it is known the world over to be. It is argument in a circle. It is not logical nor are the deductions geological. It is a pure assumption that Daemonelix is a burrow, but so easily is the mind led from pure assumptions to the conviction of their truth, that we find the author under consideration unhesitatingly pronouncing the well-known Miocene Bad Lands an aërial deposit, and denying that it is aqueous. That such a mistake could ever have been made is to be explained away on the ground of undue haste. No naturalist could deliberately pronounce our Miocene Bad Lands anything but water deposits.

Those famous Miocene beds are not wind deposits. They are not Loess. They are exactly what he says they are not, —water deposits. The Bad Lands are among the best known

ung vor, und man sieht sehr häufig Wände von mehreren 100 Fuss Höhe von unten bis oben von den Schrauben, noch mehr aber von den "Wurzelstöcken" erfüllt, welche überall an den Wänden hervorragen.

Unter solchen Verhältnissen können aber diese Miocänablagerungen umöglich Ablagerungen eines Binnensees sein, sondern wir müssen sie der Hauptsache nach für continentale Bildungen ansehen welche, wahrscheinlich grossentheils subeerischen Ursprungs in ähnliche Weise gebildet werden wie unser Löss, wie die Pampasformation und viele andere ähnliche Bildungen.

Die Angabe des Verfassers, dass das Gestein, in welchem die Daimonelix vorkommen, ein äusserst homogener, feiner Sandstein ist, stimmt mit dieser Auffassung sehr gut überein.

and most celebrated formations in the world, and are recognized as stratified aqueous deposits by every geologist.

Unless the foregoing syllogism is right and all geologists wrong, then Dr. Fuchs' gopher is left to burrow and build its nest of dry hay in one or two hundred fathoms of Miocene water.

The White River tertiary is an extensive deposit covering parts of Nebraska, Dakota and Wyoming. The depth of the deposit was originally, and still is, nearly 1,000 feet in thickness, and the time required for its deposition is estimated at 25,000 to 30,000 years. It is so plainly stratified that inexperienced students, members of my geological excursions to these regions, could make out the strata and follow them with certainty at sight. They could recognize the Titanotherium beds, lower, middle, and upper, and follow them about as they would follow the lower, middle and upper boards of an ordinary fence. So with the Oreodon beds, Metamynodon sandrock, Protoceras and others. All is stratification there, and that too so strikingly and conspicuously that no one can overlook or mistake it. The Loess, or Bluff Deposits, at the best are but obscurely stratified. They occur in southern Nebraska, Iowa, northern Kansas, and Missouri, 200 or 300 miles south of the region under discussion.

No wind could ever have formed the perfectly stratified and minutely laminated deposits of the Bad Land region. It can be formed by the assorting power of water and by that only. It is, of course, true that modern winds are functional in producing certain local surface configurations, but primarily the deposit was aqueous throughout.

He says—" It is not clear what the author writes concerning the structure of the body of Daemonelix. According to him the same seems to be filled with fine tubes, which wind about each other and give the body a spongy structure, a circumstance which the author advances, and seizes upon as important proof of the organic structure of the bodies.

" It is difficult to discuss the subject without having seen the specimen. Typical Loess is also filled with fine tubes which

intertwining give it a tufaceous or sponge-like structure, yet it is in itself no organism."

The author is entirely cognisant of the fact that Loess is penetrated by tubes—but they are vertical rather than intertwining and ramifying,—whereby are produced lines of weakness in vertical planes. The result being manifest in the sides of cañons and bluffs which are as upright as walls. This it is that gives our bluff deposits their character. Of course, ordinary meteoric water, charged more or less with carbon dioxide, percolates readily through the porous Loess, where it finds superabundance of lime salts to be dissolved out. It finds easy passage through these tubes, and as evaporation goes on and the carbon dioxide is liberated, lime carbonate is deposited as a white lining to these tubes.

In the color, and in that alone, is there any similarity between the vertical tubes in Daemonelix and those of the Loess, although we are led to the inference that they are the same.

In chemical composition the two are totally unlike. The tubes of the Loess are entirely inorganic; those of the Daemonelix are entirely organic, as every section shows. There remains then not so much as a semblence of an analogy between the tubes of the Loess and those of the Daemonelix.

In reply to the description of the characteristic and very intricately tangled tubules on the surface of Daemonelix (Figured in Pl. III of the paper criticized) he asks, "Could not this tube structure originate from the dry grass of which the gopher built his nest?" It seems to me there are two very patent reasons why this can not be. In the first place the so-called hay is not confined to the region of the supposed nest, but covers every portion of the entire fossil. The burrow then in which the gopher presumably dwelt was literally tamped with fine hay from bottom to top. Where then did the gopher and his prolific family dwell?

In the second place, if it were hay, the microscope would easily recognize it. But to the contrary the microscope shows it is not hay, because there are no fibro-vascular bundles, which grass would of necessity show; nor is there a trace of the siliceous epidermal layer which would certainly be

preserved in grasses. Nor is the arrangement of cells that of hay, but it is instead that of soft parenchymatous tissue of sea-weeds or rootlets.

Fig. 3.—A typical Daemonelix with axis. From a photograph of a specimen in the Morrill Collection, State Museum, University of Nebraska. For measurements see Fig. 5.

As for the size and general appearance, I may explain here that these tubules are not unlike a tangle of rootlets in a flower pot.

In a semi-arid region, such as this, plants are variously modified to withstand drought. Some send down roots to unusual depths, and it often happens that wells are entirely filled with great masses of fibrous rootlets especially of the cottonwood.

If we can conceive of the burrow being thus occupied it would agree much better with its general structure than hay. It would represent it still more closely if we conceive of a burrow, row, possibly abandoned, and subsequently lined by a felt of some imaginary fucoid. However, in view of all the facts, the foregoing seems untenable, and the author, although conceiving of the idea long ago, cannot believe this to be merely a vegetable lining to a burrow. Microscopic sections suggest the sea-weed, the structure being very simple. It is cellular but never vascular. It seems to me then that any attempt to show that these tubules are possibly hay, must miscarry.

"If the spiral is a filled up burrow so is the axis also, and one must admit that apparently the animal, after it had dug

the spiral burrow, in order to shorten the exit, dug yet another straight one."

"Possibly the animal used both burrows alternately, the comfortable winding one when it returned home with booty laden pouches; the shorter straight passage when it emerged light and unloaded."

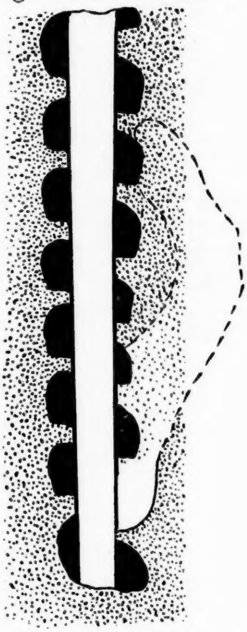

Fig. 4.—A diagrammatic figure showing the difficult, if not the mechanical impossibility of building a burrow in sand. The "Spiral Burrow" is colored black; the "Straight Burrow" is left white. The sand is represented by stippling.

"The author's observation agrees very well with this that each Daemonelix which has no central axis, but consists simply of a free spiral, has, as a rule, no transverse piece. One must certainly consider these as incomplete structures in which the side canal, with its nest and the central canal, are not yet finished."

It seems to me that the visionary argument in the foregoing crumbles as would such a burrow before it is half done. See Fig. 4. Conceive of a hollow rotunda in sand encircled by a spiral stairs and you have thought out a physical and mechanical impossibility. Grant that the sand was coherent enough to hold together till the burrow was done Can it be presumed for a moment that it could withstand the wear and tear of gophers climbing straight up this hollow passage? Yet the fossils show not a notched, scratched or rounded angle. If the Miocene gopher had burrowed in half lithified sandrock as coherent as that in which these fossils now occur, it could not resist the destruction which must result from gophers scurrying up and down its walls. But no specimen furnishes the slightest evidence of such wear.

But there are other facts militating against this burrow theory, among which the following may be mentioned. The tangled tubules which so plainly characterize the entire surface of Daemonelix often appear diffused in great irregular masses, and in broad sheets, in certain places throughout the sand rock in Daemonelix beds.

In the case of those which occur in thin sheets in cracks and fissures it is impossible that any animal ever burrowed there. Some of this plant structure then is unquestionably disconnected entirely from any burrow. What is true then of part of this organic structure may possibly be true of the whole.

It is very common indeed to notice offshoots from these corkscrews either running as supports from one coil up to the next (See Fig. 1) or running out irregularly into the surrounding matrix. These vary from the size of one millimeter to one or more centimeters and have been traced to a length of half a meter to a full meter or more.

Now it is perfectly apparent that no gopher could possibly have constructed these narrow tubes. Granting that he constructed the spiral tube how are we to account for these numerous offshoots which could not have been constructed by a gopher.

If this is in truth the work of a gopher then it must stand as a lasting monument to the genius of that creature which laid the lines of his complex abode with such invariable precision and constancy. If it were that of any of the lower forms the surprise would be less.

The difficulty alone of digging a spiral with a constant and invariable pitch seems entirely beyond the instincts of higher animals such as these quick and reasoning creatures. But besides the constancy and accuracy of pitch of the helix comes another element of great complexity, the helix tapers from top to bottom with such nicety that this animated instrument of precision would have to be sensitive to differences, not exceeding one millimeter for every 90°, in its course around the axis of the spiral. Is such precision to be expected of animals endowed with reason?

Without attempting to describe or discuss this point further the author has submitted certain figures which he believes will carry out the idea embodied in the foregoing much more tersely and emphatically than he could by verbal descriptions (See Figs. 2 and 5).

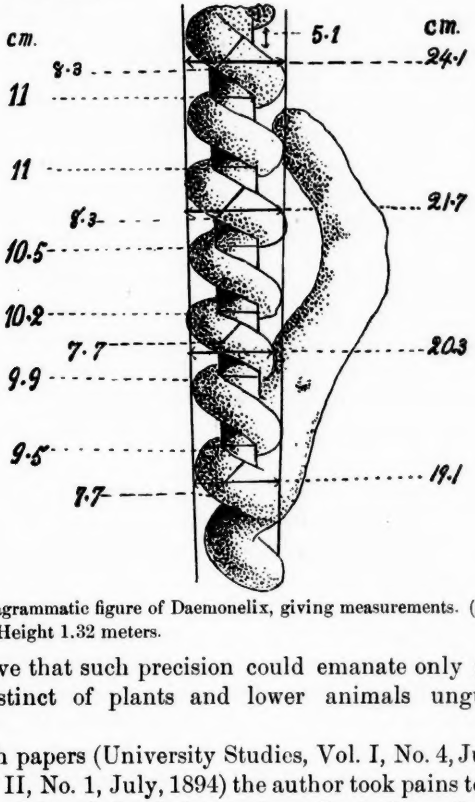

Fig. 5.—Diagrammatic figure of Daemonelix, giving measurements. (See Fig. 3.) Height 1.32 meters.

I believe that such precision could emanate only from the blind instinct of plants and lower animals unguided by reason.

In both papers (University Studies, Vol. I, No. 4, July, 1892, and Vol. II, No. 1, July, 1894) the author took pains to explain that he had found the skeleton of a rodent of exactly suitable size within the root-stalk at the base of a spiral. But in the next sentence he urged the recognition of the fact that at the same time one of his party, Mr. F. C. Kenyon, found the bones of a mammal as large as a deer, and altogether too large to have burrowed, yet it was likewise enclosed. The cork-screw

spread out and conformed to the shape and size of the bones exactly as though it had been some growth which encased them. It was accordingly suggested that possibly the small rodent had been enclosed likewise.

Touching this point Dr. Fuchs writes "In my examination I am further strengthened by finding on closer reading that the author had, at one time, found the complete skeleton of a rodent within a so-called root-stalk at its anterior extremity. The author finds it entirely inexplicable how a rodent could occur within a root-stalk and undertakes to decide the case by declaring that the rodent was submerged and that the plant had settled down and completely grown around its skeleton. I believe, however, that the author had at hand the builder of Daemonelix."

Possibly this may be so. Certainly the author conceived of the idea months before it was published that there was such a fossil in existence. But in all justice, Dr. Fuchs should have mentioned the larger skeleton also. The smaller skeleton was enclosed within Daemonelix, so was the larger. Whatever is proof in case of one ought to hold with the other, or at the least ought to have some weight.

But this much is certain that no 100 centimeter Artiodactyle Ungulate can burrow in a 20 centimeter hole. That is to say the mere fact of finding bones thus encased is not in itself unconditional proof of a burrow.

Some may raise the objection that possibly the bones of this large Artiodactyle were deposited in the sand long before the gopher dug his burrow, and that it is merely an accident that the gopher's hole passed through, or in the vicinity of, the skeleton deposited there. Granting that this is so, then we have to face this condition; the gopher in digging his burrow, dug straight through this large skeleton, through vertebræ and limb-bones alike, and yet they are not disarticulated. The joints, to the metatarsals, are in place and the zygapophyses of the vertebræ are locked in their original position.

Now can any one conceive of the possibility of a gopher digging a 20 centimeter hole straight through such a skeleton yet leaving it entirely articulate. At the least it is improbable,

and as I believe is impossible. However, if it is a possible case then it brings us to another condition; sedimentation must have gone on indefinitely long, the bones of the large animal were buried and covered by unknown feet of superimposed sediments, then the ancient lake was drained, erosion went on for an indefinite period cutting the surface into its present hills and valleys.

All this brings us then from Miocene to recent time, for it was in recent time, according to this, that the gopher must have dug his burrow through the bones of this old-time Artiodactyle. But it must be borne in mind in this connection that all these burrows are fossilized at the present time, and that the sand in which they occur is sandrock at the present time and must have been sandrock before the gopher dwelt there.

Can we believe that a gopher could excavate a burrow in rock too hard, often, even for our chisels and picks? Or has there been time for the fossilization of its burrow and bones on this supposition?

With the specimen in hand, grown over as it is with an organic network of tubules, the author can not believe that it can be accounted for in any other way than that already proposed; viz., that some organism quietly grew around these bones, conforming to their very shape and knitting them all together.

In still another case we found a small united radius and ulna in the matrix, on top of, and outside of, the root-stalk, just as if it had been deposited there as sedimentation went on One would naturally look for such bones within, not without the burrow; and on the bottom, not on the top.

The author would not be misunderstood in this reply. He does not deny the possibility of this being an old-time burrow, for such it may yet prove to be despite his fondest hopes and his avowed convictions to the contrary, and despite the very plant structure itself. But he does attempt to deny that the Bad Lands are Loess of æolian origin; that the tubes in Daemonelix are Loess tubes; that the tubules and plant cells are those of hay; and that any gopher, Miocene or modern, could possibly construct in fine sand a straight burrow inside a spiral burrow which could stand.

University of Nebraska, Dec. 1st, 1894.

ON SUCCESSIVE, PROTANDRIC AND PROTEROGYNIC HERMAPHRODITISM IN ANIMALS.

BY THOS. H. MONTGOMERY, JR., PH. D.

The term Successive Hermaphroditism has been introduced (Claparède, 9) to designate the kind of Hermaphroditism present in those animal forms, where the male and female gonads (germ glands) are in the adult separated from each other, and where the sexual products (sperma, ova) of the one sex develop earlier than those of the other. In all known cases of this form of Hermaphroditism, with perhaps the single exception of *Microstoma lineare* (Rywosch, 39, 40), the male products develop first.

Successive Hermaphroditism is prevalent in the *Plathelminthes* (with the exception of the Nemerteans) and especially in the group of the *Turbellaria.* In the *Cestodes* it has been observed in *Solenophorus megalocephalus* (Rodoz, 38) and by Zschhokke (48) in *Cestodes* which present a large number of proglottids. Ercolani (15) has proved this phase of Hermaphroditism among certain *Distomids.* In the *Turbellaria* it occurs in probably all the *Acoela* (Graff, 16). Among *Rhabdocoelida* in *Convoluta* (Claparède, 9), in *Macrostoma hystrix* and *Promeostoma ovoideum* (Graff, 16), in *Graffilla muricicola* (Ihering, 18, Böhmig, 5) and in *G. brauni* (Smidt, 42), in *Prorhynchus* (von Kennel, 19, Moore, 32a). According to Du Plessis (13) it occurs in *Plagiostoma lemani,* though the accuracy of this observation has been doubted by Graff (*l. c.*). As mentioned above, in *Microstoma lineare* according to Rywosch (39, 40) the female organs develop before the male organs. Hallez (17) has observed this phase of Hermaphroditism in a number of the *Tricladidea,* and Loman (29) in *Bipalium.* It is the rule in the *Polycladidea* (Lang, 24). Finally, Successive Hermaphroditism has been noted among the *Mollusca* in *Entoconcha* (Müller, 33), and in the *Anatinacea* (Babor, 2).

In the case of Protandric Hermaphroditism the male and female gonads are united together into a single herma-

phrodite gland (ovotestis), but the male elements are developed earlier than the female. Protandric and Successive Hermaphroditism are, however, not to be very sharply distinguished from one another. For example, in the Molluscs, where both these phases occur, we find all intermediate stages between (1) forms having a simple ovotestis, in which the male elements develop first (e. g. *Ostrea*); (2) forms, where in certain acini of a protandric ovotestis only male, in other acini only female elements are produced (e. g. *Lobiger*); and lastly (3) in forms where there are two or four separate genital glands, the male elements developing first (e. g. *Entoconcha* and the *Anatinacea*). According, though it is not proved that in all cases Successive Hermaphroditism has been evolved out of Protandric Hermaphroditism, this has very probably been the case in certain animals, as *Entoconcha* and the *Anatinacea*, which shows that these two phases of Hermaphroditism are closely connected with each other.

Protandric Hermaphroditism has been demonstrated in representatives of a large number of groups. Among sponges in *Aplysilla violacea* (Lendenfeld, 26) and *Amorphina coalita* (Topsent, 44); I wish here to express my thanks to my former teacher, Prof. F. E. Schulze of Berlin, for calling my attention to these two references. Among *Nematodes* in *Allantonema mirabile* (Leuckart, 28), and *Filaria rigida* (zur Strassen, 43). Among *Nemertinea* in *Tetrastemma kefersteini* (Marion, 30), and observed further by me (32) in *Stichostemma eilhardi*. According to Korschelt's (21) observations it is present in the polychæte Genus *Ophryotrocha*. Wheeler's (46) account of the development of the gonads of *Myzostoma* would show that in this form Protandric Hermaphroditism exists, though Beard's (3, 4) studies on the contrary would explain the state of affairs on the "complemental male" theory. Among Isopod Crustacea in three genera of the *Cymothoidæ,-Nerocila, Cymothoa, Anilocra* (Mayer, 31). Among *Echinoderms* we find it in *Asterina gibbosa* and *Amphiura squamata* (Lang, 25). But especially in the *Mollusca* is Protandry of frequent occurrence. So it occurs in the *Solenogastra* (Wiren, 47, Koren, and Danielssen, 20). In the *pulmonate Gasteropoda* in *Lymnæus* (Eisig, 14),

Agriolimax agrestis L. and *A. melanocephalus* Kal. (Babor, 1, 2). In the *Opisthobranch Gasteropoda* in *Cymbulia* (Leuckart, 27), *Cymbuliopsis* (Peck, 35); *Desmopterus papilio* (Chun, 8); *Lobiger, Clio striata, Clione, Eolis* and *Elysia* (Pelseneer, 36, 37). Among the *Lamellibranchiata* in *Ostrea* (Davaine, 12, confirmed by Van Beneden, 45). Finally, among the Vertebrates in *Myxine* (Cunningham, 11, Nansen, 34), and in *Chrysophrys* (Brock, 6).

Proterogynic Hermaphroditism is the term applied to the case of those animals, where the male and female gonads are not morphologically separate from each other, and where in the single ovotestis the female genital products are developed before the male products. It is much more restricted than the two other phases of Hermaphroditism under discussion, thus far having been observed only in pulmonate Gastropoda,—*Limax maximus* L., *Malacolimax tenellus* Nils. (Babor, 1, 2), *Agriolimax lævis* Müll. (Brock, 7; Babor, 1, 2); and among the *Tunicata* in *Salpa* (Krohn, 23; Korschelt and Heider, 22).

Since now both Proterogynic and Protandric Hermaphroditism may occur in the same genus (e. g. *Agriolimax*), these two phases of Hermaphroditism are probably closely allied. And as there exists in some cases of Protandry a cycle of development, where the individual is first male, then hermaphrodite, then female (e. g. *Stichostemma*); so there is present in some cases of Proterogyny (e. g. *Agriolimax lævis*) a similar ontogenetic cycle, only reversed, by which the individual is first female, then hermaphrodite, and lastly becomes male. In fact, I think that I am justified in concluding, that the three forms of Hermaphroditism, which form the subject of the present paper, are closely connected with each other, and their differences are more of degree than of kind.

What light does the consideration of these three phases of Hermaphroditism throw on the much discussed question,—whether in the Metazoa the hermaphroditic or whether the dioecious state should be regarded as the more primitive? Now we have found that in each phase, the products of the one sex develop earlier than the products of the other sex; accordingly, judging from the well known biogenetic law, that the

ontogeny repeats (to some extent at least) the phylogeny, we may logically conclude that the Hermaphroditism of those *Metazoa*, which present one or another of these phases of sexual development, has been secondarily acquired. This seems to me to be the only adequate explanation for such cycles of sexual development in the individual. Since the object of my present paper is only to discuss the meaning of these three kinds of Hermaphroditism, it would be irrelevant to bring into consideration the many other reasons tending to show that Hermaphroditism in the *Metazoa* is a secondarily acquired state. But this much may be remarked, that according to our argument all animal forms which present one or another of these phases of Hermaphroditism have been developed from dioecious ancestral forms; and it must be left to future investigators to show in how many forms these phases are actually present, that is, whether or not all hermaphrodite *Metazoa* are either protandric, proterogynic, or successively hermaphrodite, and whether or not all hermaphrodite *Metazoa* are, therefore, to be regarded by the argument above as having been derived from dioecious ancestors. Finally in those forms where the individual is first male (or female), then becomes hermaphroditic, and lastly female (or male), we may conclude that the hermaphrodite species in question has not only been evolved out of dioecious ancestral forms, but is perhaps also tending to become dioecious for a second time.

There now arises the question: on which sex has the hermaphroditic state been superimposed? In the case of protandric hermaphrodites, since here the male stage appears first in the ontogeny, one must suppose that it has been imposed on the male,—that ova have appeared in the testicle, and the individual has thus become hermaphroditic. Similarly, in all cases of Successive Hermaphroditism with perhaps the exception of *Microstoma lineare,* we may consider that here too the Hermaphroditism has been superimposed on male individuals. In proterogynic forms, on the contrary, the Hermaphroditism has probably been imposed on the female, since here the female stage appears ontogenetically first. Pelseneer (37) while arguing that all hermaphrodite molluscan forms have

been developed out of dioecious ancestors, endeavors to prove, that hermaphroditism here has been superimposed on the female sex alone. He bases his assumption on the fact, that in certain normally hermaphroditic Gastropods (*Cymbuliopsis, Clio striata, Helix aspera, Agriolimax lævis, Arion intermedius*) whenever an individual is found which is not hermaphroditic, it possesses the female organs only. But *Agriolimax lævis* is certainly, and *Helix* and *Arion* probably, proterogynic, so that the individuals found with female organs only, should simply be considered as individuals in the early stage before male organs have appeared. *Clio striata* on the contrary, and probably *Cymbuliopsis*, are protandric, accordingly the annotated female individuals of these two species should be regarded, as being individuals which have passed through both the early male and the hermaphroditic stage, and through the loss of all male elements had become entirely female. Thus Pelseneer's five cited cases are to be explained as being individuals in certain stages of ontogenetic sexual development, and are not to be referred to Atavism. To summarize, I agree with this zoologist that Hermaphroditism has been evolved out of the female state in all proterogynic forms, but in opposition to his views, hold that in the case of protandric forms Hermaphroditism has been superimposed on the male sex.

As to those forms, in which so-called "complemental males" are present (e. g. the *Cirripedea*, and, perhaps, *Myzostoma*), I think that these too may come under either the conception of Protandric or of Proterogynic Hermaphrodites. The complimental males could then, in the case of Protandry, be regarded as individuals which had not yet become hermaphroditic; and in the case of Proterogyny, as individuals which had passed through the ontogenetic female and hermaphroditic stages, and had become entirely male. It is perhaps more probable that Protandry and not Proterogyny has been the method of development in the Cirripedes. However, until our knowledge of ontogeny of the Cirripedes has advanced much further than its present state, the suggestions here advanced to account for the existence of complemental males can only be regarded in the light of a hypothesis.

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SPONGES: RECENT AND FOSSIL.

By Joseph F. James, M. D., M. Sc., U. S. Dept. Agriculture, Washington, D. C.

A sponge, while one of the lowest forms in the scale of animal existence, belongs to a class ranging back in time almost to the beginning of organized life. As known in a living state it is an aggregation of individuals, each one minute, but together forming a body often of considerable size. Without power of locomotion; without any differentiation of parts such as obtain in animals of a higher grade, it yet manages to subsist in a great number of places and in the greatest variety of forms. Geology tells us the family has persisted upon the earth since the earliest time of which there is any record; and at no period has it been absent from places suited for the growth of its various members. A few words about living sponges may make plainer a short account of some of the fossil forms.

The modern sponge is most familiar as an article of toilet use, varying in size from one as small as an egg to one that would fill a half-bushel basket; and differing in texture as much as in size. The gathering of this sort of sponge is a distinct trade, pursued by fishermen in many quarters of the globe, but especially in the Mediterranean. The value of the fisheries for a single year (1871), as represented at a single port (Trieste), was over half a million dollars ($540,000).

The examination of one of these sponges of commerce shows a porous structure, with a vast number of holes, some large, some small. The large ones are called "oscula." This porous body is but the skeleton, the animal matter, a sticky, gelatinous mass, having been destroyed in preparing the sponge for commercial purposes. If one of these aggregations of animalcules be studied in a living state, an interesting sight is visible.

A stream of water enters the smaller pores, is carrried by the branching canals through the interior, and is ejected from the larger openings or oscula. (Fig. 1.) The ingoing streams carry with them the food of the colony; the outgoing ones take away the waste or insoluble particles, and the water cleared of the food suitable for the growth of the individuals among which it has passed. The water is drawn into the sponge mass by the action of rapidly vibrating cilia or hairs, and it is forced out by the constant inflow thus created.

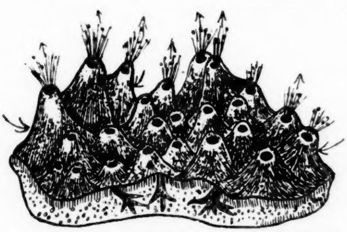


FIG 1. Portion of sponge, highly magnified, showing incurrent and excurrent streams. The arrows indicate the direction of the water. (After T. Rymer Jones.)

A close examination of the skeleton shows it to be made up of multitudes of fibres, sometimes calcareous, sometimes siliceous. In most instances siliceous spicules are found in great abundance, though these are, in certain forms, calcareous. The spicules are most diversified in form. Some are long, straight and bar-like, pointed at one or both ends or else club-shaped; some are provided with three, four, six or many branches; sometimes spines are produced, at the tips or on the sides;

sometimes there are developed at the top or bottom, cross-bars, or there is a cluster, curving upward or downward; some are

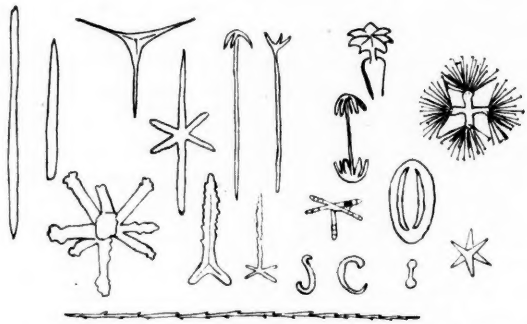


FIG. 2. Various forms of sponge spicules. (After Sollas).

shaped like harpoons, with spines along the sides, all pointing in one direction. Some are curved; some have an umbrella-like top; some are oval, star-shaped, or are developed in the form of a rosette (Fig. 2). Sometimes these spicules are simply scattered promiscuously through the fibrous net-work; but in other instances they become united during growth at their free ends, and a network is formed from which results such species as the beautiful Venus's Flower Basket sponge.

Each one of the spicules of a sponge originates in a single cell, within which it remains until fully grown. "During its growth the spicule slowly passes from the interior to the exterior of the sponge, and is finally (at least in some species) cast out as an effete product. The sponge is thus constantly producing and disengaging spicules; and in this way we may account for the extraordinary profusion of these structures in some modern marine deposits and in the ancient stratified rocks." (W. J. Sollas).

While the sponge as a mass does not show any differentiation into special parts or organs, there are frequently scattered throughout its tissues certain wandering amœboid cells. These seem to perform special purposes. Some act as scavengers; others as carries of nourishment; while some become

converted into sexual products. It is even supposed from the connection of certain cells by ganglia with groups of other cells, that there may be a few nerve fibres, with the power of converting external impressions into muscular movements.

The life history of sponges is, as yet, imperfectly known. Our knowledge can be given in a comparatively few words. Increase takes place by internal and external budding; by fission (division); and by sexual reproduction. In the method of increase by budding, a few cells become developed at some point, increase by general growth, bulge out from the cortex, and drop off to form a new colony. In internal division a mass of cells forms a globular cluster. The outer ones change so as to form an external sac. Under certain conditions the cells from the interior creep out from the enclosing sac, form a spreading mass, and give rise to a new colony. Sollas supposes these "gemmules" serve a protective purpose, and insure the persistence of the race, "since," says he, "they only appear in extreme climates on the approach of drought, and in cold ones on the approach of winter. As a secondary function they serve for the dispersal of the species; some are light enough to float down a stream, but not too far, so that there is no danger of their being carried to sea; others which are characterized by large air chambers, are possibly distributed by the wind."

Both sexes may occur in the same colony—though frequently one predominates—or they may be entirely separated. The ovum or female form develops from one of the wandering cells previously referred to, gradually increasing in size and finally passing into a resting state. The spermatozoan or male element is a minute oval or pear-shaped body with a long vibratile tail. The tailed bodies are also developed from wandering amœboid cells, each cell containing numbers of them. When mature, the spermatozoa rupture the walls of the sac where they are confined, and at a favorable opportunity enter and fertilize the ovum. After this occurs the egg begins to grow, the cells at either end assuming distinct characters. When mature, the new individual ruptures the cell wall, enters one of the canals ramifying throughout the sponge

body, and is carried out through the oscula by the out-flowing current, swimming and whirling about in a lively manner. It soon assumes a more spherical form, while a depression appearing at one end increases in depth until a cup-shaped cavity results. The young spore then settles on a rock or some other substance, mouth downwards, becoming fast to its future abiding place. It elongates and becomes a cylindrical larva; the depression at the upper end develops into an opening or osculum, and the last stage of growth of the sponge is entered upon. It has now simply to divide and increase in size to form the sponge as we know it. The process varies, of course, with different species, but the stages of egg, free swimming larva, attached larva and developed sponge are the same in all.

It is, of course, impossible to say that fossil species of sponges passed through the cycle which has been briefly described, although there is every reason to believe it to have been so. But of one thing we are certain, that in the sponges we have a group of organisms which has persisted under a great variety of forms through all the vicissitudes of the earth's career. Thousands of kinds have ceased to exist; hundreds have been preserved to us in the rocks of various formations. Yet with all the extinction that has occurred, there is not a single large group which has not both fossil and living representatives. It is, therefore, a most interesting group of organisms, and one which neither time nor changeed conditions has caused to disappear.

The oldest known series of fossil-bearing rocks in the world contains forms which belong to the sponges. Like low types that live at present, these early sponges were widely dispersed over the earth, and the same species occurs in rocks of Lower Cambrian age in Labrador on the eastern and in Nevada on the western side of the continent. One of the genera that seems to combine the features of the two great groups of corals and sponges, and whose position is, in consequence, still a matter of discussion, is known as *Ethmophyllum.* The species are simple, elongated, cup-shaped, turbinate or club-shaped; they may be curved or straight; ribbed, lobed or corrugated.

A thin membrane lines the inner and covers the outer wall, pierced by a great number of holes, while the two tissues are united by a number of septa. Dr. Dawson compares it to an

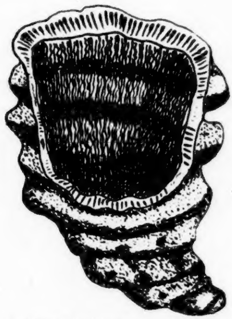


FIG. 3. *Ethmophyllum.* partly restored. (After Billings.)

FIG. 4. *Leptomitus.* (After Walcott.)

inverted cone, formed of carbonate of lime, with its point imbedded in the mud and the open cup above (Fig. 3). The lower part is composed of thick plates, enclosing communicating chambers. The cup expands above and the spaces between the two membranes are filled with sarcode or animal matter. Out from the pores projected innumerable pseudopodia, that served to convey food to the colony.

Another one of the sponges from the Lower Cambrian horizon is a member of the group to which the Glass-rope sponge belongs, and it seems to be almost the earliest progenitor of the group. It has been named *Leptomitus* (Fig 4) and consists of a long bundle of acicular threads. It represents, possibly, the anchoring body of a sponge similar to *Hyalonema* found at present in the eastern seas. In *Protospongia* is an example of a form with a very wide geographical range. It has been found in Cambrian rocks in England, in Norway and Sweden, in New Brunswick and in Nevada. The extension of this species over so wide an area is indicative of great similarity of conditions in widely separated countries. It indicates a sim-

ilarity in temperature, similar conditions of sedimentation, similar oceanic currents, and probably similar depths of water.

As time passes and we ascend the geological scale, the number and variety of genera of sponges increases. In rocks of Trenton age there has been found in a few localities in Kentucky, a form known as *Brachiospongia* (Fig. 5). It has a large, cup-shaped body, with an open, central cavity, and with from seven to thirteen arms radiating from it. No perfect specimen of this has ever been found, and the conditions of preservation have not been such as to favor the presence of the minuter features. The probabilities are that it grew on the ocean floor, fastened by a single point, with the open mouth of the cup above, and the so-called arms extending out in all directions. Its cruciform spicules ally it to certain modern living forms.

In rocks of later age occur interesting cylindrical or turbinate forms described originally as sea-weeds. The framework is in the form of a net with regular meshes, the threads crossing each other at right angles. Professor Whitfield says that the threads "are not interwoven with each other like basket work, or like the fibres of cloth, nor do they unite with each other as do vegetable substances; but one set appears to pass on the outside, and the other on the inside of the body. The threads composing the network vary in strength, and are in regular sets in both directions."

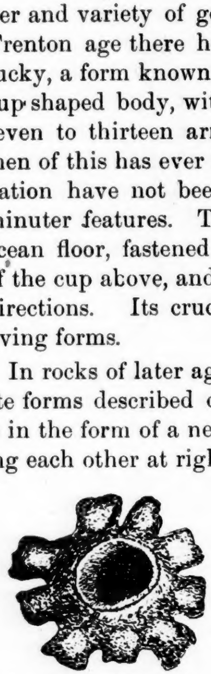


FIG. 5. *Brachiospongia;* reduced. (After Marsh).

One of the species of this family, known as *Cyathophycus*, occurs in clusters in the Utica slate rocks of New York. It is almost the earliest representative of a group that, in Devonian time, assumed a great development, and appeared in many different forms. The family is known as *Dictyospongidæ*, and presents an interesting instance of the beginning, the culmination and the dying out of a family of organisms. Beginning with the simple sac-shaped *Cyathophycus* (Fig. 6), or the globular *Rhombodictyon* in the Utica slate, it branched off into prismatic, nodulose (Fig. 7) or spinose *Dictyophytons* in the

Devonian, and died out in large, simple or rugose species in the lower Carboniferous age.

FIG. 6. *Cyathophycus.* (After Hall.)

FIG. 7. *Dictyophyton.* (After Hall.)

A variety of sponges occur in deposits of Niagara age in various parts of the world. Among these are some peculiar globular and basin-shaped forms that have been found in deposits in Tennessee, in Ohio and in Gotland. They are known as *Astylospongia*, and were free-growing and unattached. The spiculæ are star-shaped and united by their extremities into a compact whole.

One of the most interesting modern discoveries relating to fossil sponges is that showing the flint nodules so common in all deposits of Cretaceous age, to be formed largely of sponge spicules. Not only is this so, but extensive deposits of chert of Permian and Carboniferous age, have likewise been shown to be made up largely of these bodies. A remarkable paper by Dr. G. J. Hinde, describes the contents of a hollow flint, about a foot in diameter, from near Norwich, England. He gives details of finding, in about three or four ounces of dried "flint meal" from this flint, many hundreds of sponge spicules, together with remains of other organisms. Some of the

objects were so completely changed to silica, that acid had no effect upon them; while others were so entirely composed of carbonate of lime as to be dissolved. Dr. Hinde describes and figures the spicules, and says that no less than one hundred and sixty forms were observed. These he classified into thirty-eight species of thirty-two genera. Some doubt may be expressed as to the validity of these genera and species, but that the spicules occur at all is sufficient evidence of the part the sponges played in the great formations, and indicates their abundance at certain periods in the past.

Modern deep-sea dredgings have shown that sponges exist now in wonderful profusion. In the Indian Ocean, out of about a quart measure of material, no less than sixty-two species of sponges were described. Dr. Hinde in discussing the relations between the habitats of modern and fossil sponges, notes the different depths at which various Atlantic species occur. Some of these are nearly related by their spicules to forms occurring in the flint nodule; and the conclusion is reached that the species there represented could have lived in water varying from 1 to 1700 feet deep. The resemblance between the spicules found in Dr. Hinde's flint, and those occurring in nodules in Ireland, Westphalia and Belgium; and in strata varying from Cretaceous to Eocene Tertiary, indicate an extensive distribution both in space and in time.

The importance of the statement of Sollas that spicules are being continually given off by the sponge in its process of growth is seen when it becomes known that thick beds of sediment are largely formed of these bodies. It at once reduces the number of individuals which it is necessary to imagine, if these strata are formed of the effete products, rather than of the remains of individual sponges.

Two interesting facts may be noted in conclusion, relative to this group of organisms. One is the great variability it presents. Professor Alexander Agassiz says (Three Cruises of the Blake, vol. 2, p. 170) that with the group all our ideas of species are completely upset. "It seems as if in the sponges we had a mass in which the different parts might be considered as organs capable in themselves of a certain amount of

independence, yet subject to a general subordination, so that, according to Haeckel and Schmidt, we are dealing neither with individuals nor colonies in the ordinary sense of the words." He then quotes Schmidt as saying that "in place of an individual, or a colony, we find an organic mass, differentiated into organs, while the body, which feeds itself and propagates, is neither an individual nor a colony." It would thus appear that the long existence of the group has not tended to the fixation of characters, and it is probable that the tendency to variation now manifest, was just as marked in early geological time.

The other point is of interest to evolutionists. Sollas points out that the same type of canal system exists in genera of three distinct and apparently unrelated families. Further, that the development of a cortex has taken place independently, though on parallel lines, in several other distinct families. Finally, that while calcareous and siliceous spicules have had an independent origin, yet the forms of the one are repeated by the forms of the other. He comes to the conclusion that variation does not depend upon accident, "but on the operation of physical laws as mechanical in their action here as in the mineral world." If, further, he continues, "the independent evolution of similar structures is of such certain and quite common occurrence in the case of the sponges, it is also to be looked for in other groups." Thus, a multiple origin of species, instead of being an improbability, is about as likely to occur as a single origin. Identically the same variety could scarcely arise in two isolated localities, but forms now supposed to be genetically related, may have been of distinct origin.

THE MOUTH-PARTS OF THE LEPIDOPTERA.

By Vernon L. Kellogg.

By the association of the genera Hepialus and Micropteryx as a group of forms sub-ordinally distinguished from all other lepidopterous forms, and characterized by a distinctly generalized condition of certain organs of the body, a special interest attaches to the study of the morphology of these genera. If the Jugatæ, as a sub-order of the Lepidoptera, is a more generalized group than the Frenatæ the morphology of its members is to be particularly studied for suggestions regarding the primitive form of the various organs of the lepidopterous insect, and, by summation, of the racial or ancestral type-form of the order.

The commonly unqualified statement of zoological and entomological text-books that the mouth-parts of the Lepidoptera are of a type adapted for sucking, and that mandibles are wanting, or rudimentary, should not be longer repeated without qualification. It has been known since the publication of Dr. Walter's study of the mouth-parts of[1] Micropteryx that the genus presents conditions of mouth-parts obviously contradicting the common assertion, and undoubtedly the most generalized known among the Lepidoptera. The presence of functional, denticulate mandibles, combined with the absence of a maxillar proboscis, make the general statement that the Lepidoptera are characterized by the possession of sucking mouth-parts an untrue one unless suitably qualified. And although this qualification will depend upon the presence of functional mandibles in but a few species of moths belonging to a single genus, the noting of these few exceptional instances is, obviously, of extreme importance. Dr. Walter found functional, denticulate mandibles in *Micropteryx aruncella* and *M. anderschella.* Associated with the presence of the functional

[1] Walter, A., in the Jenaisch. Zeitsch. f. Naturwiss., v. 18 (1885), pp. 751–807, 2 plates.

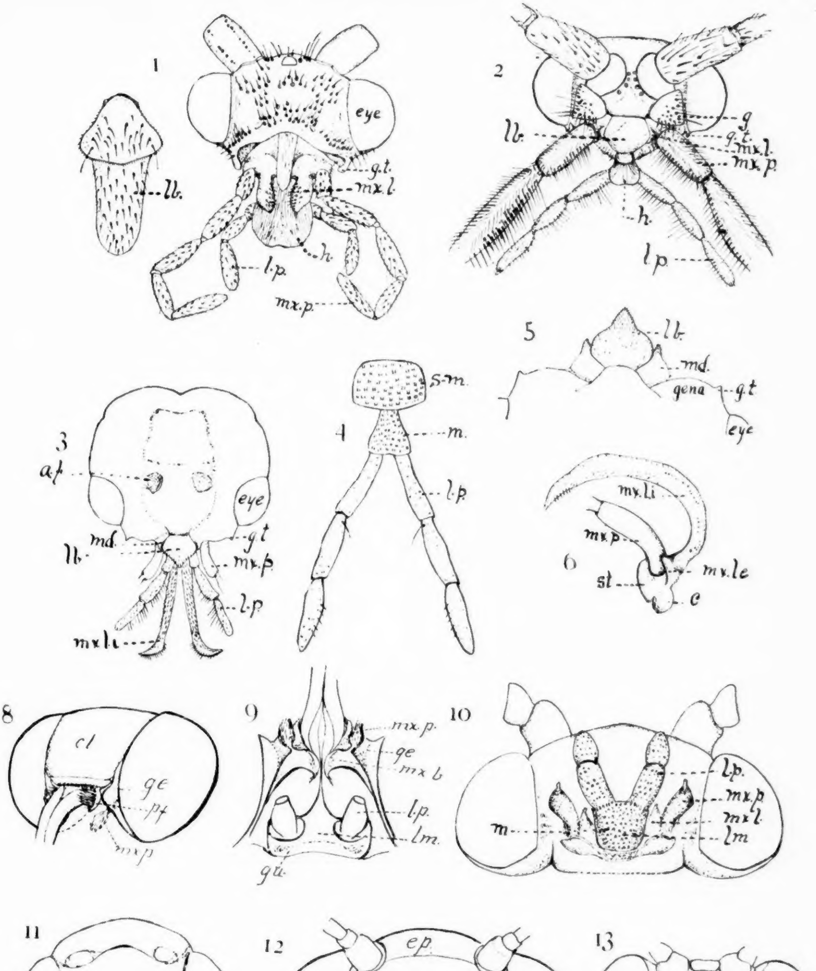
mandibles, these two species present a manifestly generalized condition of the other mouth-parts. The maxillæ possess two terminal lobes (galea and lacinia of orthopterous and biting insects generally), the outer ones, according to Dr. Walter, forming together the most primitive rudiments of a proboscis, while the inner ones form on each side a groove-like horny plate, which affords a lateral support for the labium. The lepidopterous proboscis is to be regarded therefore, according to Dr. Walter, as derived from the outer lobes (galeæ) of the maxillæ. In the higher forms the inner lobes (laciniæ) are reduced. The labium (second maxillæ) has free outer lobes, and a ligula formed by the fusion of the inner lobes into a short tubule which is open externally. Dr. Walter detected a short hypopharynx on the soft inner or hinder wall of the ligula. In *M. purpurella* and *semipurpurella* Walter found the mandibles to be without denticulations, and the maxillæ to have lost their inner lobes, the outer lobes being applied to form a typical sucking proboscis, the short organ being capable of being rolled up. The labium in these species is elongated, has no free outer lobes, and a small hypo-pharynx is discernible.

In the brief study which I have been able to make of the mouth-parts of *Micropteryx* the general conditions pointed out by Walter are apparent to me. I have examined the mouth parts of *anderschella, unimacullela, sparmanella,* and *purpurella.* In one important point, however, the few observations I have made lead me to differ from Walter in his derivation of the proboscis. It seems to me that they are the inner lobes of the maxilla (laciniæ) which go to produce the proboscis, while the outer lobes appear as short, hood-shaped processes with chitinized, firm margins, lying laterad of the base of the lacinia, and appearing as protecting or supporting processes for the inner lobes. This condition is well presented by *unimaculella.* In the maxilla (see fig. 6, plate XXV) of this species we make out a sub-circular cardo (*c*) a quadrangular stipes (st) from which arise the long, 6–segmented palpus (mx. p. x), the short, horny-margined protecting galea (mx. 1, e.), and as innermost process the long lacinia (mx. 1, i.), not fused with its mate

of the opposite side but capable of being applied to it so as to form a short proboscis. The mandibles (see fig. 5, *md,* plate XXV), of *unimaculella* are not denticulate, but single-pointed, and are not strongly chitinized, functioning rather as flexible lobes or plates than as biting jaws. The labium (see fig. 4, plate XXV), is truly lip-like, with plainly distinguished sub-mentum (*sm*), mentum (*m*), and prominent 3-segmented palpi (1, p.) rising from the outer or distal margin of the mentum. *M. purpurella* (see fig. 3, plate XXV), presents a condition of mouth-parts very like *unimaculella.* In *anderschella,* also, one of the species examined by Walter, the outer lobes again of the maxillæ are the ones which seem to me to be free, while the inner ones go to form the very rudimentary proboscis referred to by Walter. However, without study of other species the question may be left a moot one. For the object of this paper the exposition already made of the generalized state of the mouth-parts in *Micropteryx* is sufficient.

The condition of the mouth-parts of *Hepialus,* the genus associated with *Micropteryx* in the generalized sub-order *Jugatæ,* reveals an interesting further confirmation of the naturalness of the association. I have examined the mouth-parts of the *Hepialus hecta, sylvinus,* and of an undetermind species. Unfortunately, in this genus we have an atrophied or reduced condition of the parts, a functionless state, as so often met among Lepidoptera (*Bombyx et al*). This condition makes a comparison of the mouth-parts of *Hepialus* with those of *Micropteryx,* or of other Lepidoptera, difficult, but there are sufficient remaining evidences of the generally *Micropteryx*-like character of the mouth-parts to justify fully a recognition of their generalized character. Especially is this shown by the labium. In *Hepialus* sp. (fig. 10, plate XXV), the mandibles are entirely reduced, the maxillary palpi (*mx. p.*), greatly reduced, and one of the maxillary lobes lost, although one (*mx. l.*), remains in reduced state. The labium, however, retains its lip-like character, with quadrangular mentum and thick, fleshy, 2-segmented palpi (*l. p.*), very like the similar organ in *Micropteryx* and altogether unlike the fixed sclerite forming part of the floor of the head, the character assumed by the altered labium of the higher Frenatæ (see fig. 9, plate XXV).

PLATE XXV.



Kellogg on Lepidoptera.

In *Hepialus sylvinus* (see fig. 1), the labium is fleshy and lip-like, as in the undetermined species, but the palpi, short and thick, are but 1-segmented, and all that is left of the maxilla is a short ex-articulate tubercle. In *H. hecta*, the broad thick mentum bears no palpi at all, and a faint suture separates the terminal, fleshy mentum from the narrow, fixed sub-mentum. The maxillæ are represented in *sylvinus* each by a short cylindrical tubercle. Thus, despite the obscurity which obtains in the condition of the mouth-parts of *Hepialus* because of their atrophied state, it seems apparent that they are reduced from a type with free lip-like labium, and with one or more free maxillary lobes, a generalized condition only met with elsewhere among the Lepidoptera in the genus *Micropteryx*.

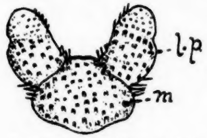


Fig. 1. Labium of *Hepialus sylvinus*; *m*, mentum; *l. p.* labial palpus.

Before proceeding to a brief consideration of certain structural features of the more specialized lepidopterous mouth-parts as presented in the Frenatæ, I wish to call attention to a few points of interest adduced from a comparison of the mouth-parts of the Jugatæ with those of the Trichoptera. Here, as elsewhere in the morphology of the Jugate and Trichopterous types,[2] the comparisons are suggestive. The morphology of the Trichopterous mouth-parts is an interesting, and by no means completed, study. Latreille and Pictet found no indications of mandibles; Kolenati and Westwood found rudimentary mandibles present. Some authors have thought the maxillæ and labium to be distinct, while Speyer and Kolbe declare them to be fused to form a sort of lapping or pseudo-sucking proboscis. Lucas[3] in his recent careful study of the mouth-parts of *Anabolia furcata* pretty conclusively demonstrates, for this species, at least, the entire absence of mandibles and the distinctness of maxillæ and labium (see fig. 1, plate XXV). In the few Trichopterous forms which I have ex-

[2] Author. The classification of Lepidoptera, in Amer. Nat., V. (Mar., 1895) pp. 248, 1 plate.

[3] Lucas, Robert, Beiträge zur Kenntnis der Mundwerkzauge der Trichoptera, Berlin, 1893. (Dissertation.)

amined, the variation in mouth-part characters is considerable. In all, the characteristic large labrum (see figs. 1 and 2, *lb.*, plate XXV), overlying the basal part, at least, of the haustellum (*h*) was present. The rudiments of mandibles were observed in but one species, *Hallesus* sp. The maxillæ present either rudiments of a free lobe, as in *Mystacides punctatus* (see fig. 2, *mx.* 1, plate XXV), or the lobe in a well-developed, sense-hair covered, probably functional condition, as in *Hallesus* sp, *Setodes* sp, *Hydropsyche scalaris*, and others. The basal part of the maxilla is sometimes pretty plainly divisible into cardo and stipes, as in *Hydropsyche scalaris;* more often, however, not. The labium usually presents a conspicuous, characteristic, expanded, and longitudinally striated flap, the haustellum (see fig. 1 and 2, *h.*, plate XXV), composed by the fusion of the terminal labial lobes. In *Hydropsyche scalaris* I was interested to discover the labium not so modified. The outer lobes were free and of rather large size; the inner lobes were represented by a pair of short, blunt tubercles, free from any indication of fusion with each other or with the outer lobes, the rudiments of free lobes.

In general the mouth-parts of the Trichoptera, where functional, may be held to exhibit the following characteristics; the absence of mandibles (or, at best, the presence of rudimentary functionless ones), maxillæ with basal portion often displaying distinguishable cardo and stipes, with functional lobes or distinct rudiments of both or of one free lobe, prominent several-segmented maxillary palpi, labium with its lobes free or coalesced to form the characteristic haustellum or lapping organ, labial palpi 3-segmented, prominent, (see figs. 1 and 2, plate XXV). Conspicuous and characteristic also is the large, flap-like labrum, which overlies the base of the haustellum, and aids materially in the half-lapping, half-sucking mode of taking food, which Lucas attributes to the Trichoptera. This conspicuous labrum is strikingly paralleled by the exceptionally large and well-developed labrum of *Micropteryx*, a feature not referred to in the previous discussion of the mouth-parts of this genus. In all the species of *Micropteryx* examined by me the labrum is large, appearing as a prominent triangular

flap, composed of a firmer basal region and a more delicate, membranous, distal region, the whole organ bearing many tactile hairs. It overlies the mouth-parts, extending beyond the mandibles and out over the fleshy labium (see figs. 3 and 5, *lb.*, plate XXV). This condition of the labrum is radically different from that presented by this organ among the Frenatæ, the more specialized Lepidoptera (see *postea*).

The long 5- to 6-segmented maxillary palpi of *Micropteryx* already pointed out in[4] Walter's admirable study of the maxillary palpi in the Lepidoptera as an indication of the generalized character of the mouth-parts of this genus, are very like, in point of number of segments and general habitus, the maxillary palpi of the Trichoptera. The maxillæ and labium in general characters are also similar in the two groups. The matter of mandibles is of special interest. In certain species of *Micropteryx* they are present as functional organs, although the tendency toward their reduction is fully displayed within the limits of the genus; in Trichoptera functional mandibles have not yet been found, although the distinct rudiments of mandibles are present. Manifestly now, as the tendency of specialization in both groups is toward a reduction to complete atrophy of the mandibles, the Jugatæ can not be looked upon as in any way lineal descendents of the Trichoptera. The affinity of the two groups must be of the character of two dichotomously divided lines of descent, diverging from a racial type which possessed conditions of mouth-parts, wing-venation, wing-clothing, and thoracic structure of a character suggested by the present conditions of these organs presented by the generalized members of the two groups.

The question of the presence or absence of rudimentary mandibles among the Trichoptera has been a bone of contention for insect morphologists, though it seems pretty obvious that if a sufficient number of species be examined both conditions

[4] Walter A., Palpus maxillaris Lepidopterorum, in Jen. Zeitsch. f. Naturwiss. v. 18, 1884. In this study Walter found that the maxillary palpi appear in a general series of lepidopterous forms from lowest moths to highest butterflies in a progressive state of reduction, 6-segmented in *Micropteryx*, entirely reduced among the Nymphalidae.

will be found. Lucas[5] devotes much space to his proof that certain small, angulated processes projecting from below the eyes, and called rudimentary mandibles by some writers, are not such, but the remnants of the lower one of a pair of tubercles which, in the pupa, marked the limits of the genal surface with which the prominent mandibles of the pupa articulated. The presence of these characteristic genal tubercles in all the species of *Micropteryx* which I have examined is worth mention (see figs. 3 and 5, *g. t.*, plate XXV). That these tubercles are not mandibular remnants (if, indeed, it is to these processes to which Savigny, Brauer, *et al.* refer) is well shown by *Micropteryx*, in which both these genal tubercles and the true mandibles or mandibular remnants are present and obviously distinct.

Passing now to the more familiarly known specialized Lepidopterous mouth-parts, a few commonly accepted beliefs demand brief reference. Moths and butterflies have been accredited with the possession of rudimentary mandibles as a general feature of the mouth-part conditions. The familiar statements and figures in entomological and zoological texts refer to certain slight projections lying on either side of the so-called labrum, a minute median triangular sclerite, as rudimentary mandibles. The statements and occasionally the figures are traceable back to[6] Savigny's enlightening study and explanation of the homologies of the insectean parts. This explanation was adopted by[7] Burgess in his description of the anatomy of *Danais archippus*. In a[8] study of the sclerites of the head of this butterfly. I became convinced that the so-called rudimentary mandibles of *Danais* are not such, but are projections from the lateral extremities of the labrum, which also, to my mind, is a larger and other sclerite than the minute triangular

[5] Lucas (*op. cit.*)

[6] Savigny, Jule-Cesar, Theorie des organes de la bouche des Crustacés et des Insects, *Insecta*, Linn., mem. 1–2, fasc. 1, partie 1, of the Memoires sur les Animaux sans Vertebres, 1816, Paris.

[7] Burgess. Edw., Contributions to the Anatomy of the Moth-weed Butterfly, *Danais archippus* Fab., 1880, Boston.

[8] Author. The Sclerites of the Head of *Danais archippus* Fab., pp. 51–57, with 1 plate in the Kas. Univ. Quart. v. 2, no. 2. Oct., 1893.

sclerite lying upon the base of the maxillar proboscis and called by Savigny, and commonly, the labrum (see *a. b. c.* of fig. 2). This minute triangular sclerite is a portion merely of the labrum, or may be indeed a true epipharynx, (i. e. process of the upper wall of the pharynx) fused, or apparently so, with the true labrum. In figure 13 of plate XXV, the cephalic aspect of the head of *archippus*, the labrum (*lb*), and its lateral projections, (*pf*), bearing on the inner margin a fringe of short, stiff, light-brown hairs, are shown. These labral processes I have called pilifers from the characteristic fringe of hairs which is always present. Rudimentary mandibles are to be found among the Lepidoptera but so far as I have observed not among the[9] Rhopalocera. When present, they uniformly arise from (i. e. are fused with) the genæ, as the mandibles normally are among insects possessing biting mouth-parts. A clear demonstration of the distinctness of pilifers and mandibles is afforded by the fact that both mandibles and pilifers are present in all cases where mandibles are found. This is well shown in the figure of the cephalic aspect of the head of *Protoparce carolina*, (fig. 12, *md.*, *pf.*, plate XXV).

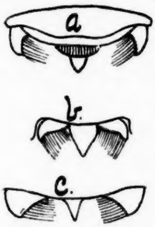


Fig. 2. The so-called labrum and mandibles according to Savigny; *a*, *Pieris daplidice* Lat.; *b*, *Nymphalis cardui* Lat.; *c*, *Zygæna scabiosæ* Fabr. (After Savigny.)

Here the conspicuous[10] mandibular rudiments, strongly chitinized at the denticulate apex, plainly arose from the genæ, and a faint articulating suture is visible. The pilifers are large, and manifestly continuous with the labral sclerite. I figure, also, the mouth-parts of *Hadena auranticolor* of same

[9] After having arrived at and published my conclusions regarding the error of designating as rudimentary mandibles the labial processes of *Danais* and the other butterflies (of all the Frenatæ, in fact), I found that Walter had previously come to the same conclusions, declaring that the parts designated by Savigny as mandibles are not such but processes of the labrum, and that the labrum of Savigny is to be regarded as an epipharynx.

[10] Despite Walter's assertion of his belief that no mandibles, even rudimentary, are to be found among the macro-lepidoptera, I cannot understand how else than as mandibular remnants these conspicuous processes articulating with the gena, chitinized and even slightly denticulate at tip, of the sphinx moths are to be interpreted.

family, Noctuidæ, as *Strigina poæ,* by which name Savigny refers to his figure of the lepidopterous mouth-parts most widely copied by subsequent authors of zoological text-books. In the figure of *Hadena* may be noted the pilifers, (see fig. 11, *pf.* plate XXV), but no indication of mandibular rudiments. In Savigny's reference to the lepidopterous mandibles he says that they are in all cases fringed very thickly with hairs on their inner margin (" + + dans tous bordées de cils très-épais sur leur tranchant interieur "), (see *a, b, c,* fig. 1). He is evidently describing the pilifers which present just this condition. Newport in his article " Insecta " in Todd's Cyclopedia of Anatomy and Physiology (1836–39), discussing the mouth-parts of *Sphinx ligustri* says : " On each side of labrum are the rudiments of the mandibles. They are two minute triangular plates attached in part to the labrum and margin of the clypeus to which, as Savigny has remarked, they appear to be soldered. They are applied to the base of the maxilla, and in *Sphinx* appear each to be formed of two parts, and are covered along their margin with hairs." As already noted, it is among the sphinges that we find conspicuous rudimentary mandibles and pilifers present, with distinct insertions and with the characteristic features of the sclerites. It is the outer one of Newport's " two parts " which is the mandibular remnant, and the inner hair-bearing one which is the labral pilifer (see fig. 12, *md.* and *pf.*, plate XXV).

This erroneous impression regarding the identity of the lepidopterous mandibles receives, as already noted, common acceptance through the representations in the standard text-books. Figure 530, p. 556, in Claus's Lehrbuch der Zoologie (5th ed., 1891) is after Savigny's original figure of the mouth parts of the Noctuid, *Strigina poæ.* The sclerites lettered *md.* and called mandibles are the pilifers. In figure 104, p. 153, in Graber's Die Insekten (1877) the sclerites lettered *k*, and designated as mandibles, are the pilifers. In Packard's Guide to the Study of Insects, on page 232, in Hyatt and Arm's Insecta, plate IX, and elsewhere, the so-called mandibles are the pilifers. In Lang's text-book of Comparative Anatomy, p. 448, fig. 307, the pilifers are figured as parts of the labrum ; the figure probably is after Walter.

Finally, I may call attention to another evident case of mistaken identity in Burgess's paper on the anatomy of *Danais*, not for the sake of picking flaws in this admirable one of the few American contributions to the knowledge of insect morphology, but for the sake of, if possible, preventing the confusion of the student of comparative insect morphology by his too willing complete acceptance of this monograph as a basis for his study of lepidopterous anatomy. Two minute, thornlike projections, one on each lateral margin of the maxillar proboscis near the base, are referred to by Burgess as the rudiments of the maxillary palpi. Now the lepidopterous proboscis is composed of the greatly elongated terminal lobes (galeæ or laciniæ) of the maxilla, while the maxillary palpi always arise from the median or sub-basal sclerite, the stipes of the typical maxilla (in reality often from a more or less distinct sclerite, the palpiger, at the side of and closely applied to the stipes). We should expect, therefore, to find any palpal remnants on the fixed basal portion of the greatly modified lepidopterous maxilla, that portion which does not enter into the composition of the proboscis, but constitutes a portion of the fixed floor of the head (see fig. 9, *mx.* b., plate XXV). Whereever the maxillary palpi or their rudiments are present among the Lepidoptera, and it is only among the highest, the most specialized, of the butterflies, that they can not be made out with certainty, these palpi or their rudiments do, in reality, arise from that very part on which our knowledge of the homologies of the insectean mouth-parts would lead us to expect to find them. This is well shown in the figure of the under side of the head of *Catocala* sp. (see fig. 9, *mx. p.*, plate XXV). Here the short, single-segmented, scale-covered palpal rudiments appear on the fixed basal part of the maxillæ, on the under side of the head, and at some little distance from the origin of the elongated, proboscis-forming, terminal lobes of the maxillæ.

Explanation of Plate XXV.

Fig. 1. *Anabolia fulcata*, cephalic aspect of head: *g. t.* genal tubercle; *mx. l.*, maxillary lobe; *mx. p.* maxillary pal-

pus; *h*, haustellum; *l. p.*, labial palpus; *lb*, labrum, removed and more enlarged. (After Lucas).

Fig. 2. *Mystacides punctatus*: *g*, gena; *g. t.*, genal tubercle; *mx. l.*, remnant of maxillary lobe; *mx. p.* basal segments of maxillary palpus; *lb*, labrum; *h*, haustellum; *l. p.*, labial palpus.

Fig. 3. *Micropteryx purpurella*: *a. f.*, antennary fossa; *md*, mandible; *lb.*, labrum; *g. t.*, genal tubercle; *mx. p.*, basal segments of maxillary palpus; *mx. l. i.*, elongated inner lobe of maxilla; *l. p.*, labial palpus.

Fig. 4. *Micropteryx unimaculella*, labium: *s-m.*, sub-mentum; *m.*, mentum; *l. p.*, labial palpus.

Fig. 5. *Micropteryx unimaculella*, cephalic margin of head, showing labrum (*lb*), mandibles (*md*), and genal tubercles (*g. t.*).

Fig. 6. *Micropteryx unimaculella*, ventral aspect of right maxilla; *c*, cardo; *st*, stipes; *mx. p.* basal segment of maxillary palpus; *mt. l. e.*, outer lobe; *mx. l. i.*, inner lobe.

Fig. 8. Catocala sp: *cl*, clypeus *g*, gena; *pf.*, pilifer; *mx. p.* maxillary palpus.

Fig. 9. Catocala sp., mesal portion of ventral aspect of head: *gu.*, gula; *lm.*, labium; *l. p.* labial palpus; *ge*, gena; *mx. b.*, fixed basal portion of maxilla; *mx. p.*, maxillary palpus.

Fig. 10. Hepialus sp., ventral aspect of head: *lm.*, labium; *m.* mentum; *l. p.*, labial palpus; *mx. l.*, remnant of maxillary lobe; *mx. p.*, remnant of maxillary palpus.

Fig. 11. *Hadena auranticolor*: *g.*, gena; *pf.*, pilifer; *mx. p.* maxillary palpus; *mx. l.*, maxillar proboscis formed of elongated maxillary lobes.

Fig. 12. *Protoparce carolina; ep.*, epicranium; *cl*, clypeus; *lb.*, labrum; *ge.*, gena; *md.*, remnant of mandibles; *pf.*, pilifer.

Fig. 13. *Danais archippus*: *g.*, gena; *lb.*, labrum; *pf.*, pilifer.

RECENT LITERATURE.

The Cambridge Natural History.[1]—This series, to be completed in 10 volumes, under the general editorship of Messrs. Clark, Harmer and Shipley, was announced some time ago, and this, the third of the series, is the first to be issued. Next to appear will probably be the insects (2 volumes) and the birds. Of the present volume 459 pages are occupied by the molluscs, and in their treatment we find much to enjoy. Most of the chapters read easily and interestingly, and the author has, apparently, thoroughly assimilated much of the recent literature relating to the life histories and habits, especially of the terrestrial forms. This side occupies the first hundred and twenty pages, and is then followed by a slight and thoroughly readable sketch of the morphology. The next section treats of the geographical distribution, and the concluding chapters are occupied with the classification in which the divisions down to families are characterized, and the principal genera enumerated merely by name.

Did space permit, we would gladly give many extracts of interesting items from the pages, for even the hints as to phylogenetic lines are treated with a freshness which demands praise—but we must forbear. We can only refer (p. 119) to the use of snails in the manufacture of artificial cream, to the chapter on pearls, and the exceedingly clear presentation of the modifications of the odontophoral teeth. Yet we note, here and there, a lapse. Thus, in the boring, by means of the odontophore (p. 237), the observations of Schiemenz are not mentioned. In the matter of the eyes of Chiton, Blumrich's results are overlooked, while through the work so thoroughly have the American printers followed the English copy that Connecticut's metropolis appears throughout as "Newhaven." The classification adopted is, in its main features, that of Pelseneer for the Gasteropods and Acephals (excepting in the matter of the Chitons and Neomenidæ), while the Cephalopods are according to Hoyle.

In their treatment of the Brachiopods, Messrs Shipley and Reed have had less of popular interest to deal with, but the accounts are clear and this portion of the work will doubtless prove of no little assistance to young paleontologists.

[1] The Cambridge Natural History, Vol. III. Mollusca, by A. H. Cooke; Brachipods (Recent), by A. E. Shipley; Brachipods (Fossil), by F. C. Reed. New York and London: Macmillan & Co., 1895; 8vo. pp. xix 535.

Regarding the affinities of Brachiopods, Shipley says, after mentioning their former association with Molluscs, Tunicates, Polyzoa, etc.: "As far as I am able to judge, their affinities seem, perhaps, to be more closely with the Gephyrea and with Phoronis than with any of the other claimants; but I think even these are too remote to justify any system of classification which would bring them together under a common name."

Judging by this single volume, the series promises well. It is well illustrated by new figures; its language is clear and simple, and seems well adapted for those who, while not professional naturalists, wish to know something more than they get from their college course, as well as for those who, deprived of suitable instructors, wish to go farther into zoological subjects than they can without aid.

Marshall's Biological Lectures and Addresses.[2]—A series of thirteen lectures, delivered by the late Arthur Milnes Marshall, between the years 1879 and 1890, has been published in book form under the supervision of C. F. Marshall. Among them are four Presidential addresses to the Manchester Microscopical Society and the discussion of the Recapitulation Theory which formed the subject of an address before the Biological Section of the British Association of Leeds in 1890. The articles are written in a clear and direct style, and are admirably adapted to instruct the general reader. We can recommend the book as introducing the principal problems of modern biology to the reader in an agreeable and comprehensible manner.

Butterfly Hunters in the Carribees.[3]—A pleasing little book, purporting to be the adventures of two boy naturalists, with their tutor, in the West Indies. The author carries the party safely through a number of adventures ingeniously contrived to bring out some scientific or historical fact. A good deal of information is imparted in an agreeable way, in some cases, however, not entirely reliable in its statements regarding matters not falling within the domain of lepidopterology. Thus, on p. 54, it is stated that a snapping-tortoise was found by the explorers! and, on p. 60, that they examined a snake allied to the pine snake of N. America, which squeezed the arm of its captor. In another place, the author lets the reader infer that blood-sucking

[2] Biological Lectures and Addresses. By Arthur M. Marshall. Edited by C. F. Marshall. London, 1894: Macmillan & Co., Publishers.

[3] Butterfly Hunters in the Carribees. By Dr. Eugene Murray-Aaron. New York, 1894. Charles Scribner's Sons, Publishers.

vampires occur in the West Indies. An interesting chapter is devoted to the habits of the rare *Papilio homerus* of Jamaica.

On the whole, the book will probably serve its purpose, viz., to stimulate young people to an active, wholesome interest in the field work of natural history.

L'Amateur de des Papillons.[4]—This handy volume is one of the series, *Bibliotheque des Connaissances utiles*, contributed by M. H. Coupin, and is intended for the use of amateur butterfly collectors. After a brief discussion of the organization and life-history of this order of insects, in the course of which is given a concise account of "mimicry," polymorphism and parthenogenesis, the author comes at once to the main idea of the work, namely, advice to the amateur collector. Descriptions of articles included in a good outfit for collecting and preserving material are followed by advice as to where and how to find different species, not only of the adult but of the chrysalid, caterpillar and egg. Finally, a chapter on mounting and displaying the collection completes this admirable book of instruction.

The book is profusely illustrated, a matter of considerable importance where the text is necessarily so concise.

Monographic Revision of the Pocket Gophers.[5]—This work is one of the North American Fauna Series, published by the U. S. Dept. of Agriculture. It has been prepared by Dr. Merriam after a critical study of over a thousand specimens, including many types, and constitutes a monograph of the family Geomyidae, exclusive of the genus Thomomys. The systematic descriptions of the genera and species are prefaced with a discussion of the morphology of the skull, and a description of some remarkable dental peculiarities as to the distribution of the enamel discovered by the author during his investigation. The opening chapter contains an interesting account of the habits and distribution of these animals, variation, both sexual and individual, and a key to the genera.

The book is well illustrated with 20 full-page plates, 71 text figures and 4 maps, 3 of which show the distribution of the different genera, and one gives the distribution of the species of Geomys and Cratogeomys.

[4] L'Amateur des Papillons. Guide pour la Chasse, la Preparation, et la Conservation. By M. Henri Coupin, Paris, 1895. B. Ballière et Fils, Editeurs.

[5] North American Fauna, No. 8. Monographic Revision of the Pocket Gophers, Family Geomyidae (Exclusive of the species of Thomomys). By Dr. C. Hart Merriam. Washington, 1895.

A *Geomys lutescens*, kept in confinement by Dr. Merriam, could run backward as rapidly and easily as forward. The well-known peculiarity of the external genitalia of the male, which are so hidden and modified that the sexes are determined with difficulty, is doubtless connected with this habit, the parts being protected from injury when the animal is moving backward. Another fact learned by Dr. Merriam from the captive Geomys is that the tail functions as an organ of touch. It is rather large and fleshy, and is apparently endowed with special tactile sensibility, and is evidently of great value in warning the animals of the presence of an enemy in the rear when they are traveling backward in their dark tunnels.

Dr. Merriam has divided these animals into several genera, but the characters regarded as definitive seem to be hardly sufficient for that purpose. They appear to us to be more properly sections of a single genus.

A Monograph of the Bats of North America.[6]—This work is one of a series of papers intended to illustrate the collections belonging to the United States National Museum. It is, in reality, a revision of a monograph published in 1864 by the same author, with such additions as have been necessitated by the study of new material. The old descriptions have been elaborated, the new standards of comparisons adopted, and many newly observed anatomical details included in the introduction.

The region covered by the monograph includes North America, extending to the southern limit of the United States.

Thirty-eight plates, of skillfully executed drawings, give the details of the external characters, of the osteology and of the dentition. The work is authoritative in this branch of N. American mammalogy, and the student of this subject will find it a *sine qua non*.

RECENT BOOKS AND PAMPHLETS.

Abbott, W. J. L.—The Ossiferous Fissures in the Valley of the Shode, near Ightham, Kent. Extr. Quart. Journ. Geol. Soc., 1894. From the author.

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General Notes.

MINERALOGY.[1]

Origin of the "Pflockstruktur" of Mellilite.—The "peg structure" ("Pflockstruktur," "Structure en chevilles") of mellilite is one of its most constant characteristics. This structure has been attributed to original glass inclusions in the mineral. Gentil[2] has recently made a careful microscopic study of this mineral from the localities of Mte. Vultura, Capo di Bove, Hohenstoffeln (Höhgau), Hochbohl, Palma (Canaries), and Rachgoun (Algiers). He concludes that the "peg structure" is due to products of decomposition of the mellilite, of which the most common is a honey-yellow hydrated substance which gelatinizes readily with hydrochloric acid. It has a lower index of refraction and a weaker double refraction than mellilite. The double refraction is so weak as to be hardly appreciable in the small thicknes of the "chevilles" and hence was supposed by Rosenbusch to be isotropic. In the mellilite of Vultura and Capo di Bove it is, however, easily made out. In the mellilites from Hochbohl and Palma the decomposition has proceeded farther, producing a zeolite, probably mesotype. This process Gentil likens to the serpentinization of olivine. The direction of development of the "chevilles" (normal to the base) is a direction of easy decomposition and is, in some cases, at least one of weak cohesion.

Blowpipe Coatings on Glass.—Goldschmidt[3] has proposed the use of a simple device for holding a small glass plate (an object or cover glass) or a mica lamella on the surface of a stick of charcoal, so that the blowpipe coatings are deposited on the glass or mica. It is thus possible to remove them and examine under the microscope or by chemical methods. The fusibility or solubility may be tested and the material is adapted to study by the methods of microchemical analysis. By use of sodium sulphide as a reagent, colored precipitates are obtained as follows: From arsenic, cadmium yellow; antimony, reddish-yellow; lead, molybdenum, tellurium, and copper chloride,

[1]Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Bull. Soc. Franç. Minér., xvii, pp. 108–119. May, 1894.

[3] Zeitsch. f. Kryst. xxi, pp. 329–333, 1893.

black; zinc and tin, unaltered. The method is of special importance in distinguishing arsenic and antimony compounds, and in determining zinc, thallium, and telluric acid.

Use of Phosphorus in Studying Minerals of High Refractive Index.—Retgers[4] uses colorless to yellow phosphorous as a medium in which to imbed small mineral grains, which, because of their high refractive index would appear black if imbedded in Canada balsam. Melted phosphorous has a very high refractive index ($n_D=2.075$) and if used in grains of the size of a pin head can be handled without danger. Such a grain is heated on an object glass till fusion begins and quickly compressed under the cover glass. The substance remains long fluid in the capillary space and consolidates clear and transparent. Rutile, brookite, and anatase are the only rock-making minerals of higher index than the phosphorous and these are brought out more clearly by it. If the mineral grains to be examined are so coarse that there is considerable danger of the oxidization of the phosphorous, the latter may be dissolved in carbon bisulphide. It is much more convenient to work with the solution but its maximum index is considerably lower than that of the fused metal.

Chalcocite from Monte Catini.—Boeris[5] has investigated some specimens of chalcocite from the Monte Catini mines, Lucca, Italy. On these crystals he has made out five forms new to the locality $\{$ (230), (012), (023), (021), (111) $\}$, and one (052) which is new to the mineral. Another new form (270), though very small, was determined with considerable probability from its zones. There is also described a new twinning law for the species, the twinning plane being a face of (011).

Diopside and Apatite from Zöptau.—Gräber[6] describes this new locality for diopside and apatite. The former appears in crystals up to 5 cm. long, which have terminations conditioned by the forms *z* (021), *p* (101), *u* (111), and *s* ($\bar{1}11$). The crystals are bright grass green and translucent. The crystals of apatite are thick tabular and ½–1 cm. long, and are either colorless or of a pale amethyst color. They occur loose in clay and in a much weathered horneblende schist. In addition to the base, first order prism, and first and second order pyramids, two-third order pyramids, μ ($12\bar{3}1$) and *u* ($13\bar{4}1$) are found on the crystals.

[4] Neues Jahrb. f. Mineral., etc., 1893, II, pp. 130–134.

[5] Zeitsch. f. Kryst:, xxiii, pp. 235–239, 1894.

[6] Tscherm. Min. u. Pet. Mitth., xiv (1894) pp. 266–270.

Serpierite.—This mineral, which comes from the Laurium Mts. in Greece, was described by Bertrand and Des Cloiseaux[7] and Damour in 1881, but no analysis was made of it. Damour described it as an insoluble hydrated basic sulphate of zinc and copper. Frenzel[8] has recently analyzed the mineral and found it to contain eight per cent of lime and very minute quantities of aluminium, chlorine, and sodium. The analysis is as follows: CuO 36.12, ZnO 13.95, CaO 8.00, SO_3 24.29, H_2O 16.75, Total 99.11. This corresponds to the empirical formula 3 (CuO ZnO CaO) SO_3+3H_2O.

Lautite.—This mineral has been considered a mixture by Groth and Weisbach. A new find from the Rudolf Schachte at Lauta, near Marienberg, Sax., is according to Frenzel[9] very pure, though it never occurs in crystals or even in large masses. The following analysis by him he considers sufficient evidence that lautite is an independent mineral:

	Percentages.	Molecular ratios.
Cu	36.10	0.568
As	45.66	0.608
S	17.88	0.559
	99.64	

The content of silver in the mineral varies from 0–12 per cent, and perhaps more.

Study of Optical Anomalies by Artificially Coloring.—Senarmont and later Otto Lehman showed that anisotropic crystals may be artificially colored by adding coloring matter to the solution in which they are forming. They thus become pleochroic. Gaubert[10] utilizes this fact in examining some pseudo-isometric crystals—the anhydrous nitrates of barium, lead, and strontium. The colored crystals obtained show six pleochroic sectors at the same instant, the opposite sectors having the same tint. If a barium nitrate solution be divided into two parts and one of these be colored with methelene blue, the colored crystals obtained have intense pleochroism, although the uncolored crystals from the other part of the solution exhibit no double refraction.

[7] Bull. Soc. Minéral. de France, iv, p. 89, 1881.

[8] Min. u. petrog. Mitth., xiv, pp. 121–130, 1894.

[9] Ibidem.

[10] Bull. Soc. Franç. Minér., xvii, pp. 121–123, May, 1894.

New Method of Illuminating in Photomicrographic Work.—Köhler[11] has suggested a method of securing even illumination of the field when artificial light is used. Instead of removing the condenser and collector from the microscope, as is usually done, thus securing an image of the source of light in the plane of the section, Köhler makes use of an accessory lens and so adjusts the condenser that a sharp image of the accessory lens is brought to the plane of the section. The object is thus uniformly illuminated, even to the margin.

Chemical Behavior of Dimorphous Minerals.—Doelter[12] has studied the comparative action of reagents on some dimorphous minerals, viz.: andalusite and kyanite, orthoclase and microcline, epidote and zoisite, enstatite and anthophyllite, diopside and actinolite, pyrite and marcasite, and sphalerite and wurtzite. Finely powdered specimens of each were subjected under similar conditions to the action of such reagents as chlorine and hydrochloric acid gases, hydrofluoric acid, potassium and sodium hydroxides, etc., to determine their relative decomposability. Marcasite is found to be less decomposed by solution of soda than pyrite. The fact that on treatment with water or sulphide of soda, the mineral which separates from the solution on evaporation is always the particular modification which was dissolved, seems to show a chemical difference between the two dimorphous forms of ZnS and those of $Fe S_2$. In many other cases the results were negative or the differences were such as might be explained by the slight chemical differences of the substances taken.

Pearls.—Though perhaps not strictly to be included in the field covered by these reviews, it seems proper to call the attention of mineralogists to the admirable paper by the late Professor Karl Möbius on pearls[13], in Velhagen and Klasing's popular magazine. This scientific paper discusses not alone the methods of fishing and extracting pearls, but describes, with the aid of beautiful figures, the different fresh and salt water mussels which bear pearls, the structure of the animal, and the manner of growth of the pearl. The structures of the pearl itself are made clear by drawings from microscopic sections, prepared by the author from a number of valuable gem pearls. The connection between the structure and surface and the value of the gem is also discussed.—Wm. H. Hobbs.

[11] Zeitsch. f. Wiss. Mikroskopie, **10**, p. 443 (1893). Abstracted in Zeitsch. f. Instrumentenkunde, **14**, pp. 410–411 (1894).

[12] Neues Jahrb. f. Miner., etc., 1894 (II), pp. 265–277.

[13] Die echten Perlen. Velhagen und Klasing's Monatshefte, IXte Jahrgang, pp. 325–335. (Nov. 1894.)

PETROGRAPHY.[1]

The Eruptive Rocks of the Christiana Region.—Brögger[2] has done an excellent piece of work in this, the first of his reports on the eruptive rocks of Norway. The article deserves much more notice than can be given it in this place. Briefly, the author describes grorudite, salvsbergite and tinguite dykes which together form what is denominated a rock series—that is, a series of rocks that differ slightly from each other in their chemical composition, but which, at the same time, by their intimate gradations into each other, give evidence of being closely related. All of these rocks are rich in soda and potassa, and all contain alkaline amphiboloids. The grorudite is essentially an aggregate of microcline and albite, usually in microperthitic intergrowths, rarely anorthoclase, and always aegerine and amphibole, as phenocysts, in a groundmass of potash feldspar, albite, sometimes soda-orthoclase, aegerine and more or less quartz. The amphiboles are arfvedsonite and katoforite, the latter name being given to a series of alkaline iron amphiboles having the angle $C \wedge c = 31°–58°$, and pleochroism as follows: $B > C > A$ = yellowish red > brownish red > yellowish red or greenish yellow. In all their properties, so far as studied, they occupy a position between barkevikite and arfvedsonite. Salvsbergite differs from grorudite in containing little or no quartz. Its structure is trachytic.

Grorudite is regarded as the dyke form of soda-granite and pantellerite and salvsbergite that of nordmarkite.

After a discussion of the significance of the notion of dyke rocks as a group of well-defined rock types, the author concludes that while the group is well characterized by Rosenbusch, it includes a number of rocks that are but apophyses of bosses, etc., and which should be classed with the rocks of bosses. He prefers the term "hypabyssische Gesteine" for all rocks with the structure of dyke rocks, whether they be in the form of true dykes, of sheets, or whether they occur as the peripheral form of bosses or laccolites. The hypabyssmal rocks comprise a great group of equal value with that of the surface (volcanic) rocks and that of the abyssmal (plutonic) rocks. It includes two classes—the aschistic and the diaschistic—the first embracing those rocks not produced by the differentiation of their source-magma, and the latter

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] Viedenskabsselskabels Skrifter. Math.-naturv. Klasse, 1894, No. 4.

those thus produced. The diaschistic rocks form complementary members, such as the minettes and aplites. The complementary form of salvsbergite is lindoite, a trachytic aggregate of phenocysts of microperthite and brown biotite, in a groundmass of quartz, biotite, aegerine and various secondary products, among which carbonates play an important *rôle*.

The laws of differentation in the different parts of the dykes are studied through the aid of a large number of carefully made analyses, as well as those governing the differentiation of the dyke masses from the boss masses. In all cases it is found that the differentiation consists in an increase in Fe_2O_3 toward the sides of the dyke, and an increase of the same constituents in the dyke masses as compared with the coroesponding boss material. The original magma is believed to have split into two magmas, one of which yielded the laccolite and boss material, and the other the substance of the diaschistic dykes. The former, in turn, split in the same way into a peripheral and a main phase, the former of which gave rise to the aschistic dykes.

The large number of analyses accompanying the discussion, and the careful description on which it is based, supply an excellent basis on which the long-desired genetic and philosophical classification of rocks may be founded, provided the lines of thought developed by the author are found to hold for other regions than those of southern Norway.

The Massive Rocks of Arran.—A very full account of the petrographical features of the massive rocks of the southern half of the Island of Arran has been given by Corstorphine[3]. The rock-types include pitchstones, quartz porphyries, normal diabase, quartzitic phases of the same rock, olivine-analcite varieties and sahlite diabases, all of which occur in sheets or dykes. The pitchstone presents no unusual characters. The quartz porphyries include those with a spherulitic groundmass and those whose groundmass is crystaline, and among the latter are microgranitic and micropegmantic varieties. The quartz-bearing diabases are usually in sheets. They contain large macroscopic quartzes and feldspars, especially near their contacts with the porphyry, and at their contacts with the underlying sandstone they contain large fragments of this rock. In the normal biabase both hypersthene and biotite occur. The large crystals of quartz and feldspar are regarded as foreign components, which have been caught up from the porphyry. The olivine analcite diabase is a typical diabase in which zeolites, and especially analcites, are abundant. These occupy the interstices be-

[3] Minn. u. Petrog. Mitth., XIV, p. 443.

tween the plagioclase and augites, and are thought to have originated from the alteration of nepheline.

Migration of Crystals from a Younger to an Older Rock.—It has long been assumed, that of two igneous rocks in contact, that containing crystals peculiar to the other was necessarily younger than the latter. Cole,[4] however, shows that crystals may be floated away into a pre-existing rock of a low degree of fusibility from one of a higher degree which has intruded it. At Glasdrumman Port, County Down, Ireland, a dyke of eurite is flanked on both sides by dykes of basaltic andesite, of which the andesites are unquestionably the older rocks, since the eurite on its contact with them encloses fragments torn from their sides. The eurite contains porphyritic crystals of pink orthoclase, while the andesite is normally devoid of them. Near its contact with the former rock, however, crystals exactly like those in the eurite are occasionally found in the andesite. Crystals of quartz and feldspar have also often been floated from the eurite into the detached fragments of the andesite. The invading rock has melted the groundmass of the andesite and has left its larger crystals scattered through a matrix made up largely of molten andesite intermingled with some eurite substance.

Notes.—In a report accompanying an excellent geological map of Essex Co., Mass., Sears[5] describes briefly the following rocks: Hornblende granitites, granophyric granitites with a flowage structure, augite-nepheline syenites, hornblende diorites, quartz-augite-diorites, muscovite-biotite-granites, norites, quartz porphyries, peridotites, gneisses, both igneous and clastic, bostonite and tinguaite dykes and various effusive rocks.

A series of chemical analyses of the gneissoid granites, granite porphyries and porphyrites of the Bachergebirge in Stiermark, has been made by Pontoni[6] in order to discover whether all the granite porphyries, that form great dyke masses in the region, have the same composition or not, and whether the small porphyrite dykes that cut the granite are like the granites and the granite porphyries or are unlike them. The conclusion reached is to the effect that the granite porphyries are identical with the gneissoid granites of the region, and that the porphyrites are independent intrusives.

[4] Scient. Trans. Roy. Dub. Soc., Vol. V, Ser. II, p. 239.

[5] Bull. Essex Inst., XXVI, 1894.

[6] Min. u. Petrog. Mitth., XIV, p. 360.

Zaleski[7] has made, with great care, a number of chemical analyses and mechanical separations of several granites to determine whether or not they are syenites plus quartz; that is, whether or not the chemical limits between which these rock types vary are fixed. His results may be tabulated as follows:

Locality.	SiO_2 Content.	SiO_2 of rock—Quartz.
Dannemora,	61.06	54.08
Nigg,	69.84	65.33
Hangö,	71.42	59.46
Baveno,	74.44	41.38

Of these granites only one possesses the silica content of syenite after the quartz has been abstracted from it.

Spurr,[8] in a bulletin on the iron-bearing rocks of the Mesabi Range in Minnesota, describes a series of fragmental and cherty rocks associated with the ores. One of these, to which he gives the name "taconite," consists of a groundmass of silica, in which are granites of a green substance, regarded by the author as glauconite. These are always more or less altered, yielding siderite, magnetite, hematite, etc. The sideritic phase of this taconite is like the original carbonate of Irving and Van Hise.

In a small collection of specimens from central and western Paraguay, Milch[9] has recognized quartzites, limestones and phonolites.

GEOLOGY AND PALEONTOLOGY.

Niagara and the Great Lakes.—Another contribution to the history of the Great Lakes is published by F. B. Taylor.[10] It is the eighth of a series and brings the history up to date. In an introduction the author refers to the recent papers of Professor J. W. Spencer and Mr. Warren Upham on the post-glacial history of the Great Lakes in the following language:—

"Prof. Spencer on the one hand levels all the higher abandoned beaches with the sea, and does not distinctly recognize a single ice-

[7] Ib., XIV, p. 342.

[8] Bull. No. X, Geol. and Nat. Hist. Survey of Minn.

[9] Min. u. Petrog. Mitth., XIV, p. 383.

[10] Amer. Journ. Sci. Arts, 1895.

dammed lake. Mr. Upham, on the other hand, ascribes nearly all submergence to ice-dammed lakes, and admits none as marine except that which is proved by fossils. As often happens in such cases, the probability is that the truth lies between these wide extremes. Ice dams have played an important part, but not to the exclusion of marine submergence even at high levels. On the other hand, marine invasion is not available as an explanation for some of the most important areas of submergence."

Mr. Taylor's views of the subject under discussion are summarized in the following chronological conspectus, taken from the last paper of his series, from which it will be seen that they are of the medium character referred to above :

"As its maximum the great Laurentide glacier covered the whole area of the Great Lakes. By a correlation of the abandoned shore lines, moraines and outlets, and the gorges, recently submerged shores and rivers of this region the following order of events is made out for the post-glacial history of the Great Lakes. They are set down in seven principal stages with transitions or critical stages between.

"1. Glacial, ice-dammed lakes. Outlets at Fort Wayne, Chicago and other places. Beaches correlated with moraines in Ohio. Glacial lakes fall by stages as outlets change on withdrawal of the glacier-dams. Land relatively high in the north but slowly subsiding.

"*First transition:* By withdrawal of glacier the Niagara river is opened and the upper lakes become united.

"II. First Niagara lakes. First epoch of Niagara Falls begins at Lewiston. For a short time glacial Lake Iroquois receives the water from Niagara. Shore lines of lower levels of this glacial lake washed over and obliterated by later marine invasion. Gradual depression of land continues at north, finally opening Nipissing outlet.

"*Second transition.*—First two-outlet climax. Marked by the Algonquin Beach. (Possible subdivision here for Trent river outlet). Gradual northward depression continues. First epoch of Niagara Falls closes at the Whirlpool. Epoch of Erigan Fall begins.

"III. First Lake Algonquin. Outlet eastward over Nipissing pass.

"*Third transition*: Gradual northward depression continues. Nipissing outlet brought down to sea level. Lakes become marine.

"IV. Warren Gulf (rising stage). Marine waters fill the three upper lakes, the Ontario, St. Lawrence, and Winnipeg basins.

"*Fourth transition:* Marine climax. Marked by the Chippewa Beach. Northward depression ceases and gradual elevation begins,

Iroquois and Herman marine beaches made at the same time as the Chippewa. This was probably the climax of the post-glacial warm epoch.

"V. Warren Gulf (falling stage). Gradual northward elevation. Irregular uplifts in the north deforming Chippewa and Algonquin beaches.

"*Fifth transition:* Nipissing outlet raised to sea level. Upper lakes become fresh.

"VI. Second Lake Algonquin. Outlet eastward over Nipissing pass. Probably a small amount of local uplift at outlet in early stage.

"*Sixth Transition:* Second two-outlet climax. Marked by the Nipissing Beach. Epoch of Erigan Fall closes at a point between 40 and 80 rods above the cantilever bridge. Second (present) epoch of Niagara Falls begins.

"VII. Second Niagara lakes (present stage). Lake Superior becomes independent. Great Champlain uplift at the northeast. Formation of St. Clair delta begins and continues to the present time." (Am. Journ. Sci., April, 1895.)

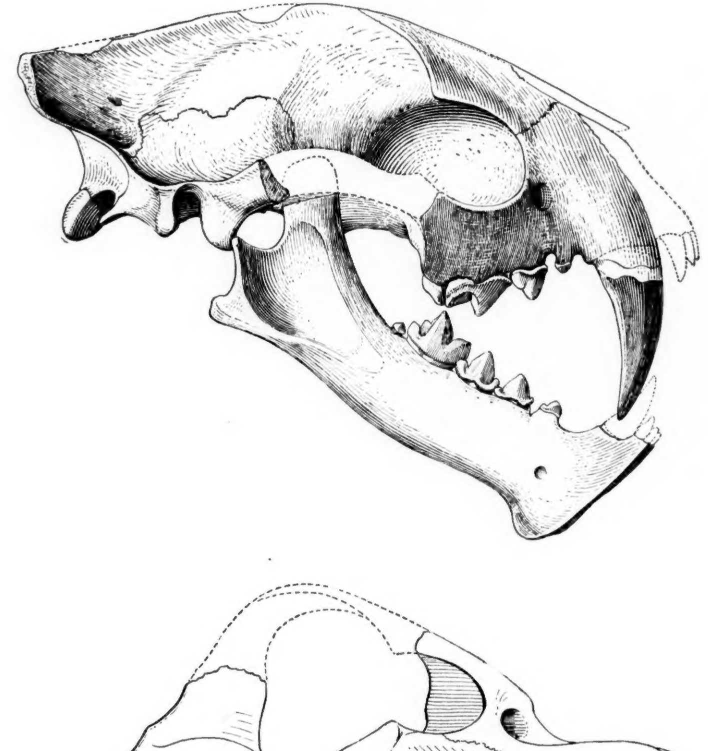
Fossil Insects.—M. Brogniart in a work on fossil insects recently published recognizes 62 genera of cockroaches represented by 137 species, many of which are new, and described for the first time by the author. Among other facts made known is the existence of carboniferous insects having three pairs of wings. Certain other species keep, in the adult form, a larval characteristic, being furnished with respiratory plates on the sides of the abdomen, comparable to those of the larvæ of modern Neuropters.

The modern cockroaches lay their eggs, generally, enclosed in an egg-bearing capsule; the Paleo-species, on the contrary, had an ovipositor and laid their eggs one by one as the grasshoppers do.

The Protolocustides and Paleacridides were jumping Orthopterons insects like the grasshoppers and katydids of the present time, but their posterior wings were as large as the anterior ones and were not folded like a fan. (Bull. Acad. Roy. des Sci. 1895.)

The Phylogeny of the Whalebone Whales.—At a meeting of the American Philosophical Society held May 3d, 1895 Prof. E. D. Cope gave an account of the types of Mystacoceti which had been discovered, and which throw considerable light on the probable phylogeny of the suborder. He pointed out that the *Zeuglodon pygmæus* of

PLATE XXVI.



Dinictis bombifrons, Adams, x ½.

Müller is in cranial characters much like Mystacoceti of the genus Cetotherium, and that it is probable that the latter were derived from the forms by the loss of their teeth. The structures of the mandibular rami of various species show the transitions from such a form to those of the right whales. Deriving the Balænidæ then from a form like that of the new genus Agorophius (type *Zeuglodon pygmæus* Müll.), we have a succession of genera in which the gingival groove and dental canal show various stages of roofing, fusion or obliteration. The genera of the Neocone beds were defined as follows.

I. Gingival groove distinct from dental canal.

Gingival groove open; *Genus not discovered.*

Gingival groove overoofed; *Siphonocetus* Cope.

II. Dental canal not distinct; gingival groove open.

Gingival tubules wanting; *Ulias* Cope.

Gingival tubules present; *Tretulias* Cope.

III. Gingival groove and dental canal fused.

Common canal roofed, and perforated by gingival tubules; *Cetotherium* Brandt.

The type of Siphonocetus is *Balæna prisca* Leidy. *S. expansus* Cope, and *S. clarkianus* Cope, sp. nov. belong to it. The type of Ulias is *U. moratus* Cope sp. nov. The type of *Tretulias* is *T. buccatus* Cope, sp. nov. To Cetotherium are referred *C. pusillum* Cope, *C. crassangulum* Cope sp. nov., *C. polyporum* Cope, and *C. cephalus* Cope. All the species of Balænidæ referred to are from the Yorktown (Middle) Neocene beds of Maryland, Virginia and N. Carolina.

Two New Species of Dinictis from the White River Beds. —The primitive saber-toothed cats are already represented in the genus Dinictis by three species; *D. felina* Leidy, *D. cyclops* Cope and *D. squalidens* Cope. To these may be added the two species described in this article, *D. fortis* and *D. bombifrons*. With the exception of *D. cyclops* from the John Day Beds of the Lower Miocene, the species are confined to the White River or Oligocene. Until the division of the White River,[1] no account of horizons was taken in collecting, but from the specimens at hand the range of the different species is indicated as follows: *D. fortis*, Titanotherium and Lower Oreodon Beds, *D. bombifrons* Lower Oreodon Beds, *D. felina*, Lower Oreodon to the Protoceras Beds.

[1] Divisions of the White River or Lower Miocene of Dakota, by J. L. Mortman, Bulletin American Museum, Nat. Hist., Vol. V, June 27, 1893.

Dinictis fortis sp. nov.

This species is based upon two specimens in the Princeton Museum, (number 11085 from the upper Titanotherium Beds and number 10933 from the Lower Oreodon Beds) which were collected by Mr. J. B. Hatcher in the summer of 1894. Number 11085, in which the front portion of the skull and the mandibular rami are preserved, is taken as the type specimen. Besides the skull there are present the distal end of the scapula, the humerus, most of the lumbar vertebræ, pelvis, proximal half of the femur, the tibia, astragalus and the bones of one digit. Of specimen 10933 there are portions of the skull showing the typical dentition and in addition to the bones of the type specimen there are the radius, ulna, scapho-lunar and additional foot bones and vertebræ, thus making it possible to give all the distinguishing characters of the species excepting those of the posterior portion of the skull.

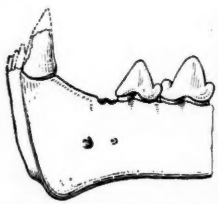


Fig. 1. *Dinictis fortis*, fragment of jaw, x ½.

Typical characters: The species differs from *D. felina* in that the muzzle is much shorter and broader and the orbital plate of the maxillary is larger and heavier. The differences in dentition are the entire absence of the paraconid of the second premolar, the larger upper canines and the more perpendicular set of the teeth as shown in the lower premolars. The skeleton is larger, the limb bones approaching in proportions those of *Hoplophoneus occidentalis* but with more slender shafts.

The Skull: The fact that the posterior portion is not preserved prevents the description of many important points, but the characters of the anterior portion are distinctive. The nasals are broader than those of *D. felina* and the premaxillaries are heavier and more rounded in their lower portion. The opening of the anterior nares is correspondingly broader. The maxillaries unite with the nasals and premaxillaries so as to form a regularly curved surface, in consequence of which the muzzle presents a rounded appearance. The orbital plate is heavier and extends farther forward, the anterior portion of the malar process of the maxillary being over the posterior root of the third premolar while in *D. felina* it is above the anterior root of the sectorial. This fact also has an important bearing on the shortening of the muzzle. The orbit is wider aud the infra-orbital foramen is distinctly larger. The anterior portion of the palate is somewhat broader, otherwise it presents no special characteristics. The horizontal ramus of the mandible

is slightly heavier, the symphysis is broader and the flanges are less accentuated. There is a low rough tuberosity on the inner superior border of the ramus opposite the second molar, similar to that mentioned by Cope as occurring in *H. oreodontis.*

Dentition: In the type specimen the crowns of all the teeth are broken off but the fangs show the dental formula to be that characteristic of the genus, I. $\frac{3}{3}$ C. $\frac{1}{1}$ M. $\frac{1}{2}$. The superior canines are more robust than is indicated by the recorded measurements of *D. felina.* In specimen 10933 from the Lower Oreodon Beds, the crowns of the third and fourth inferior premolars are preserved. They are higher, the para- and meta-conids are less trenchant and the teeth are set more nearly perpendicularly in the jaw than those of the other Nimravidæ. There are no indications of a paraconid on the third premolar.

The fore-limb: The scapula presents a large glenoid cavity to correspond with the large articular surface of the head of the humerus. The neck is stout, the coracoid process is short and heavy, the spine is thick and shows the base of the metacromion. The head of the humerus is large and the greater tuberosity rises above it but slightly. The lesser tuberosity is low and rugose. The bicipital groove is broad and shallow, contrasted with that of *D. felina,* which is narrow and deep. The ulna and radius present no special characteristics excepting their relatively larger proportions. The manus of *D. felina* has not been described but from a specimen at hand it can be seen that it was small and narrow, thus agreeing in character with the pes which is already well known.[2] The manus of *D. fortis* agrees with these characters but the scapho lunar differs in that the tubercle is set off by a distinct groove.

The hind limbs are very similar in their markings to those of *D. felina* but on the femur the line from the third trochanter to the second is incomplete and the inter-osseous line of the tibia is very sharp and well marked. These characters are present in both specimens and are probably not due to individual variation. The knee joint seems particularly large, since the shafts of the limb bones possess something of the slenderness characteristic of those of *D. felina.* While the astragulus and calcaneum are heavy, the length of the fourth metapodial shows the pes to have been long. The unguals have incipient hoods.

In the type specimen there are preserved the lumbar vertebræ and the sacrum. In the other specimen twenty-nine vertebræ are present, all of which are more or less mutilated. These indicate an animal of

[2] Notes on the Osteology and Systematic position of Dinictis felina, W. B. Scott. Proceedings of the Academy of Natural Sciences, Philadelphia, July 30, 1889.

great strength especially in the lumbar regions. The pelvis is broad and rugose, the ilium and ischium being thick and stout.

This species extends the range of *Dinictis*, this being the first specimen reported from the Titanotherium Beds, and is interesting as being more primitive and pointing to a greater antiquity for the genus.

MEASUREMENTS	D. fortis M	D. felina M
Length of bony palate,	.075	.072
Breadth of bony palate (posterior edge)	.070	.069
Breadth between canines,	.030	.026
Length of upper molar series,	.048	.049
Breadth of upper incisor series,	.028	.029
Upper canine, transverse diameter,	.010	.008
Upper canine, fore and aft diameter,	.016	.012
Length of mandible from condyle,	.126	.119
Length of lower molar series,	.055	.052
Breadth of lower incisor series,	.015	.016
Lower canine, transverse diameter,	.004	.006
Lower canine, fore and aft diameter,	.005	.008
Humerus, length,	.192	.172
Humerus, breadth, proximal end, head and great tuberosity,	.043	.038
Humerus, breadth, distal end,	.047	.042
Radius, length,	.148	
Radius greatest diameter of head,	.020	
Radius breadth of distal end,	.030	
Ulna, length,	.191	
Ulna, distance from olecranon to beak,	.030	
Ulna, distance olecranon to coronoid,	.020	
Femur, length,		.190
Femur, breadth, proximal end (head and great trochanter)	.050	.038
Femur, breadth, distal end (greatest width of condyles)	.046	.034
Tibia, length, including maleolus,	.186	.168
Tibia, breadth proximal end,	.041	.034
Tibia, breadth distal end,	.027	.020
Calcaneum, length,	.055	.043
Astragalus, length,	.035	.027
Metatarsal IV, length,	.064	.053

Diniotis bombifrons, sp. nov.

A nearly complete skull and mandible, (number 10502 in the Princeton museum) collected from the Lower Oreodon Beds by W. H. Burwell establishes a second species new to science. Unfortunately there are no other parts of the skeleton associated with it, but its size and peculiar shape are sufficiently characteristic to distinguish it at once from the species already described.

Comparing this skull with that of *D. felina*, which is the type of the genus, it is considerably larger and proportionately longer in the posterior region. At the same time it is not so high, consequently the angle of the parietals with the frontals is greater. The most striking feature is the post-orbital constriction which is situated further back of the post-orbital processes than in *D. felina* and is more pronounced, being only 31 mm. in transverse diameter. This is the concomitant of a smaller cerebral capacity. On account of the cerebral fossa being less dilated, the zygomatic processes appear more distinct and the sagittal crest is higher. The frontals are bulging and in consequence there is a median depression. This conformation would seem to indicate an enlargement of the frontal sinuses. The nasals are broad and extend behind the maxillo-frontal suture, their line of union with the frontals forming a nearly perfect semi-circle. The infra-orbital foramen is depressed well into the maxillary. Tho premaxillaries with the incisors are absent from the specimens and the anterior portion of the maxillaries is weathered away, leaving the fangs of the large canines exposed. The hard palate does not differ materially from that of *D. felina*. The opening of the posterior nares is broad in front but narrow further back where the pterygoyds curve inward. The basal region is slightly longer in proportion, the paroccipital processes are more developed and are acute. The occipital condyles are much heavier. The foramen magnum is smaller and is nearly round. The supra-occipital is produced posteriorly so that its surface looks downward. The sagittal crest and lambdoidal ridge are thin and high. As seen from above the lateral margins of the occiput are parallel and the inion is regularly curved.

The mandible is longer, corresponding with the elongation of the skull and the flanges are low and heavy. The dentition is not essentially different from *D. felina* except in the large, compressed superior canines. The superior molar is somewhat reduced, the second inferior molar has a single root and is just on the point of disappearing, and there is a short diastema between the second and third premolars, but these characters may not prove constant. The postero-internal cusp of

the lower sectorial has been shown to be an inconstant character in the genus. In this specimen it is well developed.

Measurements	D. bombifrons M	D. felina M
Length of skull, condyles to premaxillaries,	.185	.154
Length of skull including overhanging occiput,	.205	
Length of cranium to anterior rim of orbit,	.130	.108
Length of face,	.055	.046
Distance from anterior rim of orbit to post-orbital constriction,	.065	.050
Length of bony palate,	.074	.072
Breadth of bony palate, posterior portion,	.070	.069
Breadth between canines,	.025	.026
Distance from foramen magnum to line of post-glenoid process,	.039	.033
Distance from foramen magnum to line of mastoid processes,	.0195	.0195
Length of upper molar series,	.046	.049
Length of upper canine,	.050	
Upper canine, transverse diameter,	.010	.008
Upper canine, fore and aft diameter,	.019	.012
Length of mandible from condyle,	.132	.119
Length of lower molar series,	.055	.052
Lower canine, transverse diameter,	.007	.006
Lower canine, fore and aft diameter,	.110	.008

Geo. I. Adams.

Geological News, Paleozoic.—Mr. Beecher's study of a series of *Trinucleus concentricus* Eaton, a trilobite departing widely from the common form, substantiates the conclusions of Barrande as to the generic value of the ocular tubercle and eye-line. They clearly represent adolescent characters.

In regard to the appendages of *T. concentricus*, Professors Verrill and Smith agree that they indicate an animal of burrowing habit, which probably lived in the mud of the sea-bottom, after the fashion of the modern Limulus. In addition to its limuloid form, the absence of eyes favors this assumption, so does the fact that many specimens have been found preserving the cast of the alimentary canal, showing that

the animal gorged itself with mud like many other sea-bottom animals. (Am. Journ. Sci., Vol. XLIX, 1895.)

The eruptive rock in south central Wisconsin, classified as quartz porphyry by the state geologists, is described in detail by Weidman. The formation represents a volcanic outflow which took place over beds of Upper Huronian quartzite. The normal rock is a quartz keratophyre, but along the contact line with the quartzite occurs a zone of sericite schist from 150 to 200 feet wide. These schists are a dynamic alteration of the quartz keratophyre, and are not as Irving supposed, related to the Magnesian schists of Devil's Lake. A third type of rock belonging to the series is volcanic breccia varying in size from an inch to a foot in diameter. The areal extent of the eruptive rock is greater than was formerly supposed. It was during an elevation which followed the outflow, that the overlying porphyry was metamorphosed, in part, into schist. (Bull. Univ. Wisc. Sci. Ser., Vol. I, 1895.)

MESOZOIC.—M. Sauvage classifies the Dinosaurs found in the Upper Jurassic beds of Boulogue from 1863 up to the present time as follows:

Sub-order Sauropoda.

Fam. *Atlantosauridæ, Morinosaurus typus* Svg.; *Pelorosaurus precursor* Sog. Fam. ? *Dinosaurien* de *grande taille.*

Sub-order Theropoda.

Fam. *Megalosauridæ, Megalosaurus insignis* E. E. Desl.

Sub-order Ornithopoda.

Fam. *Iguanodontidæ. Iguanodon prestwichii* Hulke. (Bull. Soc. Geol. de France [1894] 1895.)

Geological News.—PLISTOCENE.—A study of the topography and distribution of the typical eskers of New England brings Mr. J. B. Woodworth to the conclusion that they are most easily explained by a subglacial origin, but segments occur where the cross-section departs from the limitations of the type and demands a channel open to the sky. (Proceeds. Boston, Soc. Nat. Hist., 1894.)

Mr. R. E. Dodge offers the following hypothesis to account for the terraces of the Connecticut River:

The Connecticut River occupies such a well-marked valley that it must have been the drainage channel of a large amount of water caused by the melting of the great glacier that overlay some portion of its valley. A part if not all of the waste in the terraces must have been

lain down during the presence of the ice. Afterwards a decreased volume and a rising land will account for the rest of the work done in postglacial times. In other words, the upper terrace plain is due to a glacial accident in the river's history, and the upper escarpment was formed as the river cut down toward base-level after the land rose when relieved from the weight of ice. The later terraces formed as the river sank its channel deeper into the glacial waste, each terrace plain representing the temporary level of the stream, and each escarpment showing intermittently rising land. (Proceeds. Boston, Soc. Nat. Hist., Vol. XXVI, 1894.)

A fossil mandible in the Museum at Brisbane, Queensland, is referred by Mr. De Vis to Zygomaturus. In commenting on the supposed identity of this genus with Nototherium Owen, the author says that this mandible shows the two genera to be distinct and that Zygomaturus, and its three allies, Diprotodon, Nototherium, and Euowenia, form a natural family of the phascolomine section of the marsupials. (Proc. Roy. Soc. Queensland, Vol. XI, 1895.)

BOTANY.[1]

Progress of the Botanical Survey of Nebraska.—From data recently obtained the following statement is made of the progress of the Botanical Survey of Nebraska. From its beginning, several years ago, the Survey has been a private enterprise, supported and encouraged by the University of Nebraska, the State Board of Agriculture, and the State Horticultural Society. The immediate work is in the hands of the Botanical Seminar, an organization of graduates of the botanical department of the University of Nebraska. Through the energy of the members of the Seminar expeditions have been made from time to time to nearly all parts of the State, and in some cases these have been of extended duration. The first considerable publication was made in 1890 when H. J. Webber's "Catalogue of the Flora of Nebraska" appeared in the Report of the State Board of Agriculture. Reprints of this catalogue were issued under separate cover, and these have formed the basis of subsequent work and publication. This catalogue, unlike many local publications of its kind, was based upon

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

actual specimens in the possession of the author, with a few exceptions where species were admitted on the authority of recent scientific publications.

In this catalogue 1,890 species were enumerated, almost equally divided between the flowerless and flowering plants. Important additions were made by members of the Seminar during the two years following the publication of the catalogue, and early in 1892, Mr. Webber published an " Appendix " to his first catalogue. This, with other additions published at the same time in a " Supplementary List," brought the whole number of species up to nearly 2,500 not quite equally divided between flowerless and flowering plants, the latter exceeding the former by about 150. A year later, 1893, in the " Report on Collections made in 1892 " 162 species were added, and in the " Report for 1893 " published in 1894, 184 additions were made, bringing the whole number of species (after making necessary corrections) up to abont 2,820, again almost equally divided between flowerless and flowering plants. The collections made last year, now nearly worked up, will amount to about 220 or more species, so that the list of known species now approximates 3,050. The flowerless plants now surpass the phanerogams, there being fully 1,600 of the former, to about 1,450 of the latter. From this time forward the ascendency of the lower plants is assured, since it is quite certain that by far the larger part of the flowering plants have already been catalogued.

Throughout the work, the original rule of basing all additions upon actual specimens has been adhered to, and in all the later work every specimen has been deposited in the Herbarium of the Survey. Some of the earlier collections are still in the private herbaria of members of the Seminar, but these will doubtless eventually be deposited in the Survey Herbarium also.

Along special lines a more particular study of the distribution of species has been made; thus the distribution of the woody plants has been mapped for each species, the whole including a series of small maps on which the area covered by each species is indicated by red-ink shading. In addition the data so obtained have been published in the bulletins of the Experiment Station (No. 18, 1891), the Annual Report of the Nebraska State Horticultural Society (1892), and the Annual Report of the Nebraska State Board of Agriculture (1894). Sixty-four trees and seventy-seven shrubs are now known to occur in the State, and their distribution is already quite well known.

The final reports of the Survey are to take the form of a systematic descriptive work, in which every species is to be fully described, accom-

panied by illustrations of all the genera. This publication is to bear the name "Flora of Nebraska" and will be issued in "parts" as the material is ready for publication. It is estimated that twenty-five parts of about fifty pages each, will be required to complete this work. In August of last year Parts I and II were issued. They cover the classes Schizophyceæ, Chlorophyceæ, Coleochæteæ, Rhodophyceæ and Charophyceæ, and are illustrated by thirty-six plates. Part XXII, the Calyciflorae, is nearly ready for the press, and will probably appear about the middle of the year. The plates, of which there will be eleven, are already made, and will illustrate the more difficult species and genera.

CHARLES E. BESSEY.

Pharmaceutical Botany.—A few months ago Professor Sayre's book "A Manual of Organic Materia Medica and Pharmacognosy" was issued by Blakiston & Co. of Philadelphia. An examination of the work, and some use of it in the laboratory show that it is well adapted to the use for which it was designed. The introductory chapters, devoted to an outline of Morphological and Structural Botany, will enable the student without other preparation to take up the work of the body of the book. The sequence of pharmaceutical products is strictly botanical, beginning with those which are derived from the Ranunculaceæ, and ending with Irish Moss from one of the Red algæ. The descriptions are good, and there are numerous illustrations, many of which are very good, while even the cruder ones will prove useful to the young pharmacist. Aside from its high value in pharmaceutical botany, it will be a useful reference book in any botanical laboratory.

Professor Bastin has recently added another useful book "Laboratory Exercises in Botany" (published by W. B. Saunders, Phila.) to his well known series. Although not distinctly so stated, it is especially suited to the wants of students in Medical Colleges, and those who are preparing to take up Pharmaceutical Botany, and for these it will be of much service. The numerous illustrations, while often not artistic, have the merit of making their meaning plain. The two books might very profitably be used together.

VEGETABLE PHYSIOLOGY.[1]

What becomes of the Flagella?—Some authors have insisted that the flagella of swarm spores are finally absorbed into the body of the spore, while others have maintained that they are cast off. In a recently published paper embodying the results of many careful examinations (Ueber das Schicksal der Cilien bei den Zoosporen der Phycomyceten) Rothert shows that both views are correct. In the second swarm stage of Saprolegnia and in the Peronosporeae the flagella are either cast off as soon as the spore comes to rest or soon after, or else they remain attached to the spore indefinitely, even after germination. In the first swarm stage of Saprolegnia, however, he found to his surprise that they are as uniformly drawn back into the body of the protoplasm, the withdrawal being slow at first and then quite rapid. In both cases, more especially in the former, the old flagella are strongly inclined to turn back on themselves and form fused loops, the reason for which is not very apparent. These loops are formed while the flagellum is attached to the spore or after it has been cast off and may occur in any part of it, the straight part of the flagellum being drawn back into the loop which becomes, thereby, little if any larger, but increases noticeably in thickness. These loops usually form within 1 to 3 minutes after the spore comes to rest. The author believes the looping movement is due to the vital activity of the flagellum, the subsequent drawing in of the straight part being accounted for by surface tension. He points out that purely physical causes would leave the flagella straight, or cause them to swell, or make them contract into balls. While not committing himself to the view, it is suggested that possibly the flagella are formed out of a special cytoplasm existing only in small quantity, and that at the end of the first swarm stage of diaplanetic swarm spores this is carefully husbanded for future use. The observations were made on Pythium complens, on a member of an undescribed genus nearest related to Phytophthora, on Saprolegnia monoica, and on an undetermined species of Saprolegnia, the spores being sown in hanging drops.—Erwin F. Smith.

Perithecial Stage of the Apple-Scab Fungus.—In *Berichte d. d. bot. Gesellschaft* XII, 9, pp. 338–342 R. Aderhold describes the

[1] This department is edited by Erwin F. Smith, Department of Agriculture Washington, D. C.

results of his observations and cultures, concluding that Venturia chlorospora f. Mali is the much sought for ascosporous stage of Fusicladium dendriticum (Wallr.). In culture media of apple and pear broth and the same with addition of gelatin, he found the mycelium and conidia obtained from the ascospores of the Venturia to be identical with those obtained from the conidia of the Fusicladium taken directly from the host plant. He did not succeed in growing perithecia either from ascospores or conidia, neither was he able to demonstrate that the scab can be produced by inoculations with these ascospores, owing to the fact that his experiment was tried in a locality where the disease made its appearance in unexpected abundance so as to confuse results. The evidence, therefore, rests on association and the supposed identity of the fungi which he obtained from ascospores and from conidia. The author states that without previous knowledge it was impossible to tell whether a given culture was derived from a conidium or an ascospore, and maintains that even without inoculatians he has fully established the genetic relationship of the two fungi, this argument will not, however, be fully convincing to others. The perithecia are round to oval with club-shaped, 8-spored asci ; spores brown, 2-celled, the forward end smaller, 11–15x7–8μ. At Proskau in 1893, the asci were ripe the last of March, in 1894, the middle of April. In gelatin cultures the mycelium penetrated to the depth of a centimeter and formed superficially a dense black down, becoming gray-black with age. No pycnidia were observed, but round or oval pseudo-parenchymatic bodies finally formed in the cultures, and these were supposed to be incipient perithecia. Two closely related species of Venturia (V. chlorospora and V. ditricha f. piri) were found on old pear leaves attacked by Fusicladium, and because the extruded ascospores are exactly alike, so that the author could not tell with which he was working, the identity of apple and pear scab is also left for future determination. Altogether it would seem to have been better had the author held back the paper so as to include the results of another year, inasmuch as he intends to continue the investigation.—Erwin F. Smith.

Poisonous Cactaceae.—The reports of certain Mexican travellers (last of all Lumholtz) that the Indians of that region become intoxicated by eating certain species of cactus seem to have more truth in them than botanists generally have been willing to admit. Recently from Anhalonium Lewinii of northern Mexico, Lewin has isolated an alkaloid anhalonin, which is said to resemble the alkaloids found in many species of Strychnos. It was obtained pure, and both warm and cold

blooded animals were subjected to its effects. Per kilo of the animals experimented upon 0.02–0.04 grams caused severe poisoning and 0.16–0.20 grams caused death. This is not the only poisonous cactus. Four other species of Anhalonium (Echinocactus) were examined and found to be poisonous in varying degrees. Of the genus Mammillaria five species were examined, one of which (M. uberiformis) is noxious. More surprising still, the juice of Rhipsalis conferta was also found to be poisonous to cold blooded animals. The author thinks that other species of cacti will turn out to be poisonous, and expresses the hope that some of the alkaloids may be of service in medicine. These notes are from *Ber. d. d. bot. Gesellschaft*, XII, 9, pp. 283–290. Another paper by the same author giving the toxicological, chemical and crystallographical data in detail may be found in *Archiv f. ex. Path. u. Pharmak.*, Bd., 34, 1894.—Erwin F. Smith.

Rothert on Heliotropism.—The last number of Cohn's *Beiträge* (No. 1, Bd. VII, pp. VIII, 212) is wholly given up to a paper on Heliotropism by Dr. W. Rothert, privat docent of the University of Kazan. Many experiments were performed with monocotyledonous and dicotyledonous seedlings, leaf-blades, petioles and stems, and some interesting results were obtained which it may be possible to abstract hereafter. Among other things he concludes that Wiesner's "Zugwachstum" has no foundation in fact. There are no plates, but many simple figures illustrating curvatures are introduced into the text. The work was done in Leipsic in Dr. Pfeffer's laboratory.—Erwin F. Smith.

Austro-German Views on Botanical Nomenclature.—At the 66th meeting of the German Naturalists and Physicians held in Vienna in September, 1894, the section of Systematic Botany passed the following resolutions:

(1) The rule that a name once used but subsequently invalid shall never again be used is to be recommended for future observance, but retroactive power (once a synonym always a synonym) shall not be given to this rule, and names which have been changed for this reason shall be rejected.

(2) As a rule, the original species name is to be retained when a species is removed from the original genus to another.

(3) In questions of priority the year 1753 shall be retained as the point of departure both for names of species and genera.

(4) In the naming of species the principle of priority should govern, but a sure name shall not be thrust aside for a doubtful one.

(5) In the naming of genera a name that has been disused for 50 years shall not be revived to displace one which has been in use.

(6) This rule permits of one exception, i. e., when the name in question has been in use 50 years since its revival.

These rules were drawn by two botanists of world-wide reputation, Drs. Ascherson and Engler, and are accompanied by some pages of explanation and remarks which deserve the serious attention of all who are interested in nomenclature. It is unnecessary to say that Otto Kuntze and his followers receive considerable attention and plenty of sharp criticism. Of course, as Briquet has already remarked concerning the rules adopted at Rochester and those suggested by himself and other individuals, these rules must be adopted by an International Congress before they can have any binding force. Botanical nomenclature is an international affair, and the absurdity of a few individuals or even all of a certain country getting together and trying to dictate to the rest of the world is self evident. The rules here translated and the remarks alluded to will be found in *Oesterreichische Botanische Zeitschrift,* XLV, No. I, Jan., 1895, pp. 27–35.— Erwin F. Smith.

Separation of Enzymes.—The 18th An. Rept. Conn. Agricultural Exp. Sta. (1894) contains a number of papers of interest, notably three by Thomas B. Osborne on The Proteids of the Rye Kernel, The Proteids of Barley, and the Chemical Nature of Diastase. On methods of extraction, he has the following:

"The usual method of preparing vegetable enzymes is to treat the aqueous or glycerin extract containing them with alcohol as long as a precipitate having fermentative power appears, to purify this by repeated precipitation from its solution in water, by means of alcohol, and finally to subject the aqueous solution to dialysis to remove salts. This method is wholly unsuited to yield pure preparations, because the precipitate produced by alcohol contains not only a large amount of carbohydrates and salts, but also nearly all of the various forms of proteid matter present in the extract.

"The most rational method (hitherto very little used) is first to separate the proteids from the carbohydrates and other soluble substances by saturating the extract with ammonium sulphate, thereby precipitating the ferment and proteids together, next to remove the proteid existing as globulin, by dialysis, and then, if possible, to separate the albumin and proteoses by fractional precipitation with alcohol." By this method a diastatic ferment was isolated from malt which was capable at 20° C. of producing "from soluble starch, over 2000 times its weight of maltose, and a further undetermined quantity of dexterin, within one hour."—Erwin F. Smith.

ZOOLOGY.

Habits of Limpets.—It has long been known that the common limpet (*Patella vulgata*) settles down on some eligible spot (its "scar") between tide-marks, and makes a home, to which it returns after having been out to feed. This locality-sense has been supposed to be independent of smell, sight and touch, so far as the head tentacles are concerned. Mr. Lloyd Morgan, however, has shown (Nature, Dec. 6, 1894) that the head tentacles are the sense-organs concerned with this "homing" power. Later observations made by J. R. A. Davis, at the Scottish Marine Section, confirm Mr. Morgan's conclusions, to some extent, but Mr. Davis is inclined to think that the mantle tentacles may help in the homing.

Mr. Davis notes also that this homing faculty is not confined to Patella, but is also possessed by *Helcion pellucidum.* The object of this habit seems to be protection from the assaults of the incoming or outgoing tide. (Nature, March, 1895).

Life-History of the Lobster.—With a view to the artificial culture of the Lobster, Mr. Samuel Garman has undertaken to study the life-history of this animal, and has published the following notes on their breeding habits:

1. The female lobster lays her eggs but once in two years.

The normal time of deposition is when the water has attained its summer temperature, varying with seasons and places; the period extends from about the middle of June to the middle of September.

3. The eggs do not hatch until the following summer, that is, for a year. The time of hatching varies also with the temperature, and extends from the middle of May to the last of August.

The Gas in the Swim-bladder of Deep-Sea Fishes.—During the last scientific voyage of the yacht *Princess Alice*, commanded by Prince Monaco, M. Jules Richard had an opportunity of analyizing the gas in the swim-bladder of several species of deep-sea fishes. Serranus, from a depth of 60 meters, and congers, taken from a depth of 175 meters off the bank of the Gorringe, showed more than 80 per cent. of oxygen. The rest of the gas was nitrogen with traces of CO_2. The proportion of oxygen was such that it was easy to perform the well known experiment of lighting a candle by holding one in the

gas, having previously lighted and extinguished it, leaving only a spark to start combustion. *Simenchelys parasiticus*, taken in a bow-net from 1674 meters' depth in the neighborhood of Corogne, showed 78 per cent. oxygen, that is to say, less than Serranus from 60 meters' depth. The law stated by Biot, that the proportion of oxygen increases with the depth is in default. Some other influences must be taken into account. (Revue Scientifique, April, 1895).

A New Locality for Abastor erythrogrammus.—I recently saw excavated from a clay bank on the Pamunkey River, Virginia, two specimens of the *Abastor erythrogrammus*. This is very far north of the most northern locality known in the east, which is South Carolina, although it has been found in the Austoriparian area in Southern Illinois. The locality mentioned is outside of that area and is in the Carolinian district. That the species is a burrower allied to Carphophiops is attested not only by its structure but by its habits. According to Mr. A. E. Brown, it has been dug from mounds in Florida at a considerable distance below the surface by Mr. C. B. Moore.

E. D. Cope.

The Cold-Storage Warehouse Cat.—A story has been going the rounds of newspapers, both west and east, to the effect that a new breed of cats has been produced in the cold-storage warehouses of Pittsburg. In some of the papers, reference was made to a new species of rat with the bodies clothed with remarkably long thick fur, with even the tails covered with a thick growth of hair. The rats had adapted themselves to a low temperature, and the cats were the result of breeding from artificial selection in order to obtain a cat to prey on the new rat. According to the story, after several failures, a brood of seven kittens, the progeny of a mother possessing unusually thick fur, was raised in the rooms of the storage company, and developed into sturdy, thick-furred cats, with shortened tails, and "feelers" five or six inches in length. This latter character was said to be probably due to their environment, since they must necessarily live in semi-darkness. Another peculiarity of the new cat is its inability to live in an ordinary temperature. When removed from the warehouse to the open air, especially in summer time, it will die of convulsions in a few hours.

This story was reprinted in England in some excellent scientific journals, which showed a great lack of caution in appropriating anything supposed to be new in science from a newspaper. It illustrates once more the English tendency to neglect the good and discover the

bad in American affairs. Mrs. Alice Bodington, however, redeemed the reputation of her countrymen by writing to the Secretary of the Cold Storage Co., to ascertain the facts in the case. She received the following reply:

"While there is some foundation for the newspaper article, it is somewhat exaggerated. Our cold storage house is separated into rooms of various sizes, varying from 10° to 40° above zero.

"About a year ago we discovered mice in one of the rooms of the cold storage house. We removed one of the cats from the general warehouse to the room referred to in the cold storage house. While there, she had a litter of several kittens. Four of these were transferred into one of the general warehouses, leaving three in the cold storage house. After the kittens were old enough to take care of themselves, we put the old cat back into the house we had taken her from. The change of climate or temperature seemed to affect her almost immediately. She got very weak and languid. We placed her again in the cold storage room, when she immediately revived.

"While the feelers of the cats in the cold storage room are of the usual length, the fur is thick and the cats are larger, stronger and healthier than the cats in any of the other warehouses."

Thus the only result of the change of environment was the usual one which ensues on the advent of winter in extratropical latitudes generally. It is interesting as showing that the effect is really produced by the low temperature, and is not a survival through natural selection of a chance variation, as a certain school of evolutionists would have us believe.

A New Harvest Mouse from Florida.—In a paper entitled "Contributions to the Mammalogy of Florida," published in the Proceedings of the Acrdemy of Natural Sciences of Philadelphia, in 1894, I had the pleasure of recording the first capture of a *Reithrodontomys* in Florida.

This specimen seemed to indicate good sub-specific characters in comparison with *R. humilis* of more northern latitudes, but owing to its apparent immaturity, I decided to postpone a description until other specimens were taken.

Subsequently, Mr. F. M. Chapman recorded, in the Bulletin of the American Museum of Natural History, of 1894, the taking of another specimen. The apparent rarity is confirmed by the experience of my friend Mr. Outram Bangs, who, in a list of about five hundred specimens of rodents taken by him in Florida the present winter (1894-5),

does not enumerate a single specimen of the Harvest Mouse. I have just received a second specimen from Mr. Dickinson, who sent me the first one, and, as this is an adult in perfect condition and fully confirms the peculiar characters of number one, it may form the type of the following diagnosis:

Reithrodontomys humilis dickinsoni.[1] Type ad. ♀, No. 2240, col. of S. N. Rhoads. Col. by W. S. Dickinson, at Willow Oak, Pasco Co., Florida, Apr. 6th, 1895.

Description: Size considerably smaller than *R. humilis.* Color above, uniform plumbeous gray, almost sooty, slightly darker along middle of back and rump, and a faint wash of light brown on sides. Tail above like back; below, grayish, like feet and under parts. Skull as in *humilis,* but distinctly smaller.

Measurements: Total length, 118; tail vertebræ, 56; hind foot, 15. Skull, total length, 18·3; basilar length, 13·6; length of nasals, 6·1; interorbital constriction, 3·1; zygomatic expansion, 9·6; length of mandible, 10; width of mandible, 4·7 mm.

This race of the common eastern Harvest Mouse conforms to the peculiarities of the Floridian as contrasted with the Carolinian environment in the same way that its allies and neighbors of the genera *Sigmodon* and *Peromyscus* have done, *viz.*, in the diminuition of brown and rusty colors and the acquirement of a more or less darkened shade of gray.

—Samuel N. Rhoads.

EMBRYOLOGY.[1]

Grafting Amphibia.—Professor G. Born has published a preliminary notice[2] of some novel experiments made upon the young tadpoles of various amphibia.

In studying regenerative processes in young tadpoles he observed that when a tadpole was cut into two pieces, the pieces might unite

[1] Named for Mr. W. S. Dickinson of Tarpon Springs, Fla. in recognition of of his valuable services in the collecting of Florida mammals.

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

[2] Jahresbericht d. Schlesischen Gesell. f. vat. Cultur Sitz., June 8, 1894.

again if kept close together. This led to a series of experiments that, at the time of publication, furnished the results enumerated below.

He used larvæ that were ready to escape from the egg jelly or those that had just escaped. They were put into 6% solution of sodium chloride and cut across with scissors or a scalpel into an anterior and posterior half. The pieces were at once brought together and held in place by various means till they grew together completely. Subsequently they were transferred to a fresh supply of the salt solution. It was found to be easy to get two tail pieces to unite, since the cilia that normally move the animal forward would push the two tails toward one another. With other pieces various artificies were necessary to prevent the ciliated action or the muscular contraction moving the wounded surfaces apart before union had taken place.

1. When the tail ends of two tadpoles of *Rana esculenta* are placed with the cut ends together, they unite in twenty-four hours quite completely, so that there is little external evidence of the line of fusion. These joined tails live for eight days and increase in length; they then degenerate and become dropsical.

The union may be made direct with the dorsal and ventral sides continuous in the two, or inverted with the dorsal of one continuous with the ventral side of the other. When very long pieces are taken a heart may develop in each, while in seven days there is an increase in length, for the two, of 2.9 mm. from a length of 15.6 mm.

It is also possible to unite such a long posterior part with a shorter posterior part; then the head of a larva is replaced by the tail and belly of another growing forward in its place.

2. The anterior ends of two larvæ may be made to unite. This succeeds more readily with the younger stages. Here again the union may be direct or inverted. In one case of the latter method of fusion, two that had been cut across in the region of the liver, remained united for fourteen days, during which time much differentiation took place in each head.

In the larvæ of the newt, triton, union of anterior pieces was affected, but this was less complete than in the case of the frog tadpoles.

3. Complex unions of two larvæ may result when the cuts are not quite complete and the two pieces of each remain connected by a slender bridge of tissue; the two pieces may be folded back side by side, and then pushed against the similar pieces of the other larva. The opposite ends of two larvæ may then fuse together while still remaining attached to their own proper terminations.

4. The anterior part of one larva may be united to the posterior part of another individual.

When the pieces are long, the same region is repeated in the resulting fusion, since it is present in the posterior part of one larva and in the anterior part of the other. In only one case, however, did this experiment succeed. After five days there had been much growth, but the intestine had not fused across the line of union and there was no circulation in the posterior piece.

5. Two frog larvæ may be easily united belly to belly so that a true twin is formed.

The animals may be united with the ends reversed as well as with the heads and tails in the same direction.

6. It is even possible to unite larvæ of different genera even of different families.

The posterior end of a frog larva was fused to the anterior end of a triton larva.

The anterior end of a frog larva and the posterior end of a toad larva (*Bombinator igneus*) were readily united. The inverse of this last experiment also succeeded.

7. The larvæ of *Rana esculenta* and *Bombinator igneus* were united belly to belly, producing a true double monster, gastrophagus, made up of animals of two different genera.

The Embryo of the Duckbill.—At the meeting of the Linnean Society of New South Wales, Nov. 28, 1894, J. P. Hill and C. J. Martin read a description of an embryo of the duckbill taken from an intrauterine egg. The embryo described was taken from one of two eggs just ready to be laid. The egg measured 18 mm. by 13.5, being somewhat larger than the eggs described by Caldwell. The embryo was found lying on the surface of a thin-walled vesicle with its long axis corresponding to the long axis of the egg.

It measured 19 mm. in length from the anterior end of the medullary plate to the posterior end of the primitive streak. The vesicle on which the embryo lay consisted of two layers all over, with the mesoderm extending about half way round between and comparable to a typical mammalian blastodermic vesicle. The vesicle filled the whole of the egg, and contained a thin albuminous fluid together with a thin layer of yolk spheres next to its wall. The embryo with the exception of a slight head fold, is quite flat. Medullary folds are absent except in the most anterior region of the future fore-brain, where slight lateral upgrowths of the medullary plate appear. The three cerebral vesicles

are indicated, and in the region of the hind brain four well-marked neuromeres exist. External to the 2d, 3d, and 4th neuromeres is an extensive auditory plate, already slightly grooved. There are seventeen somites, which, in the middle region of the trunk, possess distinct cavities, and externally to these from the 4th to the 17th, are situated the beginnings of the Wolffian bodies. At the 7th somite the Wolffian duct is first seen, the appearance of which in sections suggests an ectodermal origin. Double heart origins are present, but there is no trace of a vascular area besides a slight mottling in and around the area pellucida. A distinct blastopore is present with a neurenteric canal, which runs through the head process and opens into the archenteron (yolk-sac cavity). The primitive streak extends behind the blastopore to a distance of 1.5 mm. The embryo more nearly resembles that of the Virginia opossum (Didelphys) of 73 hours described by Selenka, than any other embryo known to the authors. The Platypus embryo is, however, much longer.—Zool. Anzeiger, 1895, p. 31. K.

ANTHROPOLOGY.[1]

The Antiquity of Man in North America.—The problem of the antiquity of man on this continent has received some interesting contributions within the last few years, and it will be interesting to take a survey of its present condition.

The sources of information respecting the first human inhabitants of a country are four-fold—two-fold as to materials, and two-fold as to localities. The materials may be either his bones or his handiwork ; the localities are deposits which are either within caves or outside of caves. The bones of primitive man have shown that there was, in Europe, and possibly in Asia (Java), a species of the Genus Homo distinct from the *H. sapiens*, which has been called *H. neanderthalensis.* This being possessed all the characters of the skeleton, dentition, etc., which belong

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

to the lowest existing races of men, and had, in addition, a transverse ridge across the inner side of the symphysis of the lower jaw above the genioglossal tuberosity, from which it is separated by a deep transverse valley. Nothing like this occurs in any existing race of the *Homo sapiens*. If any person is disposed to dispute the claim of the *Homo neanderthalensis* to recognition as a species, let him reflect that the diversities presented by the existing races of the *Homo sapiens* are, in some instances, of the kind regarded in zoology as both specific and even generic, and that they are not so regarded is because of the existence of numerous intermediate forms. The peculiarities presented by the Neanderthal man (including, in this term, the people of Spy, Naulette, Shipka, etc.), found in a few of the lowest races are the small cranial capacity, the larger size and quadrituberculy of the last superior molar, etc., while the conformation of the symphysis is not seen in any of them, and is of such a character as to indicate wide divergence in zoological affinity. His small cranial capacity has been shown by Virchow to be matched by that of a Nigrito of the Andamans, where it is as low as 950 ccm., an inhabitant of New Britain, 860 ccm.; Nilgiri, India, 960 ccm.; New Ireland, 970 ccm., and of Abyssinia 975 ccm. No trace of the skeleton of the Neanderthal man has been found in North America. The skull found in the Gold Bearing Gravel of Calaveras Co., California, was without lower jaw, so that its specific position cannot be determined. The cranium proper, however, does not resemble that of the older species. The same is true of the man of Sarasota Bay, Florida; and the man of the baths of Peñon near the city of Mexico had the usual type of lower jaw. For the present, then, this species of man may be left out of account in the present discussion.

Whether, after the subtraction of the Neanderthal species, the history of *Homo sapiens* can be divided into a paleolithic and a neolithic age, or whether the Neanderthal man was the only paleolithic man, remains for consideration. The man who made the turtle-backs of the gravels of the valleys of the Thames and of the Somme, is supposed to be truly paleolithic. Mr. Boyd Dawkins finds, however, that their bone fishing-spears are identical in character with those made and used by the (Esquimaux) Inuit, and he suggests that, in the glacial period, these people existed in southern Europe with the reindeer and other arctic mammals appropriate to the climate. And now comes Mr. Frank Cushing, who declares that not only the spears, but all the other bone instruments and implements of reindeer-horn and bone found in the

[3] Verhandlungen d. Berliner Anthrop. Gesselsch., 1894, p. 506.

French caves, and supposed to be of paleolithic age, are now in actual use among the Inuit of the Arctic regions of America. The coincidence covers so many kinds of implements, and the appropriateness of the environment is so plain, that the conclusion is almost irresistible, that the river valley paleolithic people were, as Boyd Dawkins supposed, Inuit. But no crania or jaws of these people have been discovered, so that it is not known whether they possessed the dental characters which I have shown to characterize this race.[3] It would be remarkable for this race to have immediately succeeded the Neanderthal man in Europe, since the two present dental characters at the extremes of the range of variation in the Genus Homo, so that they would be regarded as good genera zoologically speaking, were it not that the rest of mankind intervenes between them. Bone barbed spear heads of the Inuit pattern have been found in Ohio. The neolithic men of Europe do not differ in cranial or dental characters from the majority of men, so far as they are known. They were not Inuit.

It is well known that Messrs Holmes[4] and Maguire[5] have endeavored to prove not only that there was no paleolithic man in North America, but that his existence in Europe is problematical. Paleolithic flints they regard as rejected cores from which fragments have been split for the manufacture of better implements. European authorities do not admit this, but maintain the validity of paleolithic man. The question to my mind is, however, more complex than it was. If the Neanderthal man is the paleolithic man, then he existed beyond a shadow of a doubt. But the river-drift men were totally distinct, probably Inuit. Did any other paleolithic man exist? The chances of proving the existence of such a man in Europe are diminished but not extinguished.

If we turn to North America, the evidence of the existence of any man but the so-called Indian on this continent is insignificant compared with the evidence for primitive man which exists in Europe, but, such as it is, it is important. Paleolithic flints have been found at Little Falls in Minnesota, at Newcomerstown in Ohio, and paleolithic argillites near Trenton, New Jersey, in beds of plistocene age more or less related to glacial conditions. The attempts of Mr. W. H. Holmes to discredit these alleged discoveries does not appear to me to be successful. His criticism of the great manufactory of turtle-backs at Piney Branch near Washington, D. C., which he believes to be the refuse of an arrow

[3] Amer. Journal of Morphology, 1888, p. 7.

[4] Journal of Geology, 1893, p. 147; American Geologist, 1893, p. 219.

[5] American Anthropologist, 1893, p. 307; American Naturalist, 1895, p. 26.

factory, is worthy of closer attention. In any case, the evidence from glacial deposits of the existence of paleolithic man in America is not yet very considerable.

If we turn to the caves, we have, at least, the opportunity in this country of demonstrating the existence or non-existence of Cave Dwellers. Between 1868 and 1871, I explored the contents of three ossiferous caves; one in Tennesee, one in Virginia, and one in Pennsylvania. No report was made on the contents of the first, as the material was sent to a museum in Philadelphia and was never seen after. Reports[6] on the other two were published. All of these caves are situated south of the terminal moraine of Lewis and Wright. A report on the contents of Hartman's Cave in Northampton Co., Pennsylvania, within the line of the terminal moraine, was made[7] by Professor Leidy in 1887. These investigations brought to light the existence of a definite fauna, which I have called the Megalonyx fauna, and which is the last of the extinct faunas of North America. It includes the extinct genera of Mammalia, Platygonus, Smilodon, Megalonyx, Mylodon, Mastodon, and extinct species of Bos, Dicotyles, Equus, Tapirus, Ursus, Castor, Arvicola and Lagomys. Teeth and other fragments are found which are not distinguishable from the following species now existing in the country; *Cervus virginianus, Canis lupus, Ursus arctos, Vulpes virginianus, Procyon lotor, Didelphys virginianus, Lepus sylvaticus, Arctomys monax, Castor fiber.* These remains are enclosed in a red calcareous clay, which, when dry, forms a matrix of moderate hardness, similar to that observed in the bone caves of Europe and Asia.

It may be here remarked that the bone caves of the world so far as explored, present us with an oldest fauna of about the same age. They nowhere include fossil remains of animals of an age prior to the Plistocene. This I have had occasion to verify on specimens brought from the caves of Mount Carmel, Syria by Sir William Dawson, as well as on the American material already mentioned, and as has been long since shown with regard to the caves in Europe. And this in spite of the fact that bone caves exist in all limestone formations from the Cambrian upwards, and have doubtless commenced their formation so soon as the respective limestones were sufficiently elevated to be subject to the soluble and erosive effect of water flowing in its fissures. The plain inference is that all those parts of the caves which represent this

[6] Proceeds. Amer. Philos. Soc., 1869, p. 171. Ibid., 1871, p. 73.

[7] Annual Report of the Geological Survey of Pennsylvania, 1887, p. 1.

work which was accomplished prior to the Plistocene age with their contents, have been removed by atmospheric and other erosion.

The explorations in American caves conducted by Mr. H. C. Mercer of the University of Pennsylvania in the last two years, have thrown interesting light on the subject. He examined some twenty five caves[8] and rock shelters situated in the valleys of the Tennessee, Kanawha and Ohio Rivers with great care, digging trenches to bed rock, noting the deposits in their bottoms, and saving all the fragments met with, carefully classified as to position, etc. *In only one of these did he find a slight trace of the Megalonyx fauna,* and in this case only in a stratum at the bottom. In all the others were found the bones of the existing wild fauna of the country, the mammalia, birds, reptiles and fishes, with bones, pottery, and flints of the American Indian. The sole exception mentioned was the Lookout Cave, Tennessee, where in a bed of red clay at the bottom, there were found a jaw of a *Tapirus haysii,* and of a small Mylodon. The cave deposits encountered were loose and nowhere indurated as in the caves containing the Megalonyx fauna explored by myself. It is perfectly clear from these results that there exist cave deposits of two ages in eastern North America, the one containing the existing fauna and the Indian, and the other containing the Megalonyx fauna, *and which has so far yielded no traces of the existence of man.*

What cause exterminated this populous fauna of large and small Mammalia from the North American Continent? Some of its features are distinctly South American. Such are the genera of sloths, Mylodon, and by relationship Megalonyx, although the genus did not occur in the Southern Continent. Such are the genus Smilodon, and the species of peccaries and tapirs, and the great rodent Castoroides which probably belongs to the same. The nearest approach to members of this fauna in N. America are the peccary of Texas and the tapir of Mexico. The appearance of the caves of this period throws some light on the question. The Virginian bone breccia which I examined was the floor of a cave only, the cave itself had been carried away by some powerful agency. The Tennessee cave was a steeply descending shaft which had been filled to the mouth. I found it most convenient to break from the roof of a hole which pierced the deposit, the fragments of matrix which contained the bones. The cave at Port Kennedy on the Schuylkill River, Penna., is a fissure, and it is packed from floor to opening with alternating deposits of clay and vegetable

[8] AMERICAN NATURALIST, 1894, pp. 355, 626.

debris mixed with fragments of limestone and wood. In my opinion all of these caves have been submerged, and their contained deposits are rearranged sediments. The later caves have not been submerged since they received their present contents. The difference in the age of the respective deposits is, then, considerable. In the case of the Lookout Cave, Tennessee, explored by Mr. Mercer, a part of the old cave deposit remained, and was covered by the modern bed.

Geologic history presents us with a submergence at the middle of the Plistocene period, precisely such as constitutes the culminating point of every geologic system. This has been termed by Dana the Champlain epoch, and we may well retain the name in a broadened sense for the continental submergence to which we owe not only the Champlain and Erie formations of the North, but the Columbia gravels of the Middle and Southern States, so thoroughly studied by McGee. That the submergence was not without short reversed movements and oscillations has been shown by Spencer, but that it was continental in extent there can be no doubt. It is also clear that it was followed by an emergence, which constitutes the Terrace epoch of Dana's system. We are then led to the conclusion that the fauna of the Megalonyx epoch is pre-Champlain, and that of the later caves post-Champlain. The country was, however, not probably wholly submerged. Some species, mostly the smaller ones, and the genus Megalonyx, survived on the not submerged land, and these we find to be common to the two faunas. The Hartman's cave, within the limit of the ice sheet, is on a hill now elevated 800 feet above the level of the Delaware River. That it was subjected to submergence is shown by the stratified clay with which it is even now partly filled. Its fauna does not include all the types of the Megalonyx fauna, and does include the Castoroides, as shown by Leidy. It includes a larger proportion of existing species than the usual Megalonyx fauna. Its peculiarities are probably due to its northern latitude.

This submergence corresponds with the one which Professor Prestwich insists effected Europe subsequent to the glacial elevation.[9] The Paleolithic flints of Kent he thinks demonstrate such a submergence, and his reasoning as to the character of the deposits in the European caves applies exactly to the bone breccias of the Megalonyx age of our caves here.

The existence of Paleolithic man in North America has not yet been demonstrated by the cave explorations so far as they have gone. We can, however, only consider this conclusion as one which may be re-

[9] Transac. Royal Soc. London, 1893, p. 903.

versed at any time. The state of affairs on the Pacific Coast may be stated as throwing considerable light on the subject.

The Equus beds are found covering areas of various extent in Oregon, Nevada, California, the Staked Plains, Southern Texas, Chihuahua and the valley of Mexico. Their most eastern station is western Nebraska. They contain a fauna which includes one extinct species (*Equus major* Dek.) of the Megalonyx fauna, and the recent *Castor fiber*. They contain the extinct genus of sloths Mylodon, of a species different from that of the east, and four species of camels of the extinct genus Holomeniscus, and a peccary. Recent species of Canis and Thomomys occur, while two extinct horses (*Equus occidentalis* Leidy and *E. tau* Owen) are common. The hairy elephant (*E. primigenius*) is abundant, while the *Mastodon americanus* is rare, if occurring at all. The proportion of recent to extinct species and genera in the Equus bed fauna is very similar to that occurring in the Megalonyx fauna, while they differ as to details.[10] This fauna has also disappeared from the continent, a few species, as in the east, surviving to a later date. Was its disappearance due to a submergence as in the east? The appearance of the beds in Texas leads us to suppose that such was the case; while the deposit in Oregon appears to me to be that of a lake now desiccated. The gold-bearing gravel of California, which is also Plistocene, must have been the result of floods, and its wide distribution and stratification resemble conditions due to submergence. Whether the Equus fauna was destroyed more or less by submergence or not, the rëelevation of the Sierra Nevada introduced a period of desiccation to the east of it, before which all large mammals remaining must have succumbed.

The remains of man have been shown to occur in the gold-bearing gravels. I have found them (obsidian spear and arrow heads) in profusion mixed with the bones of the extinct fauna at Fossil Lake, Oregon, in a friable and wind-blown formation. This man, however, so far at least as regards California was not Paleolithic, since he made smoothly ground pestles and mortars.

There is, therefore, considerable probability that man was a contemporary of the Equus fauna, and the Equus fauna was contemporary with the Megalonyx fauna of the east.—E. D. Cope.

Paleolithic Man.—*To the Editor of the American Naturalist*:—

Dear Sir:—In the January number of your estimable Journal,

[10] See American Naturalist, 1889, p. 160, for a partial list of the species of this fauna.

there appeared on page 28, the following statement: "* * *in America the friends of paleolithic man have with few exceptions deserted the proposition as an unsupportable theory.*"

Without raising any discussion upon the theory of the paleolithic age in America, I desire to enter my protest against the correctness of the foregoing conclusion.

There may be those who believe the existence of a paleolithic period in America is not yet proved; who only believe in its probability and do not reject the evidence cited in its favor; but of all those thus classed, I know of none who "have *deserted the proposition as an unsupportable* theory."

Respectfully,
THOMAS WILSON.

The Smithsonian Institution, Washington, Jan. 30th, 1895.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—April 17th—The following paper was read: Prof. William Libbey, Jr., "Two Months in Greenland;" stereopticon views were shown.

May 1st.—The reports of the Curator, Secretary, Librarian, Treasurer and Trustees were read, also the report of the Walker Prize Committee. The election of officers for 1895–96 was held. The following paper was read: Mr. J. L. Tilton, "On the Geology of the Southwestern Part of the Boston Basin."

May 15th.—The following papers were read: Prof. Thomas Dwight, "Notes on the Dissection of a Chimpanzee, with Especial Reference to the Brain." Prof. N. S. Shaler, "The Conditions of Escape of Gases from the Interior of the Earth."—SAMUEL HENSHAW, *Secretary.*

Academy of Science of St. Louis.—April 15th.—Miss Mary E. Murtfeldt presented a paper on "The Habits of Certain Seed-Feeding Insects."—A. W. DOUGLAS, *Recording Secretary.*

American Philosophical Society.—April 19th.—Dr. D. G. Brinton read a paper on the "Proto-historic Ethnography of Western Asia."

May 17th.—Dr. D. G. Brinton read an obituary notice of the late Dr. W. S. W. Ruschenberger. Mr. R. Meade Bache made a few remarks on "Personal Equation." Prof. E. D. Cope read a paper on "The Pamunkey Formation of the Chesapeake Region and its Fauna." Mr. J. G. Rosengarten read an obituary notice of the late Prof. Henry Coppée.

Proceedings of the Natural Science Association of Staten Island.—Dec. 8th, 1894.—Mr. Walter C. Kerr exhibited numerous maple leaves injured by storm and read the following:

Survival of Storm-Injured Leaves—During the last summer it was frequently remarked that the late spring frosts had seriously injured the young foliage, several gentlemen having commented upon the damage thus wrought to their shade trees. My attention was first attracted, on May 27th, to the wilted appearance of the leaves of a white oak on Richmond terrace, near Stuyvesant place, and later to the similar condition of the Norway maples on DeKalb street. A search for parasitic fungi as the cause revealed nothing, and it was not until a gardener suggested the wind that the true explanation appeared. This, perhaps, should have been more apparent, although few seem to have suspected the real cause. The damage was so general that it contributed a conspicuous feature to our summer's foliage throughout our eastern and southern exposures, as has already been incidentally mentioned in the Proceedings for October in connection with the effects upon the Cicadas.

The storm, which lasted several days, began on May 20th, and the trees then in foliage all suffered more or less, the extent of damage seeming to be proportional to the size of the leaves. The white oaks and the maples having the largest leaves at that season, were lashed and bruised in a somewhat interesting, if not remarkable, manner. Fruit trees were also considerably injured. Few, if any, leaves were killed. They seem rather to have been injured in spots, chiefly at the tips, though also along the edges and through the blades of the leaves, extending inward from the sinuses, withering at these points while the remainder of the surface was unharmed. Some were split radially along their weakest sections, withering on the edges of the split. In some, over three-fourths of the surface was killed, the shape, however, being preserved intact, the other fourth remaining green and healthy. It is difficult to describe their appearance, but the specimens submitted will indicate the peculiar way in which they were affected by the injury. The general appearance of the trees has been too common all summer

to require special comment. Similar injuries are reported by Mr. William T. Davis and Mr. Charles W. Leng, as observed, especially on the leaves of oaks and maples, at Newfoundland, N. J., where a high ridge furnishes opportunity for exposure.

With easterly storms so prevalent on our coast, it is strange to find so conspicuous a result from a storm possessing no unusual characteristics, and the simplest explanation would obviously be that it occurred just at a time when many leaves were sufficiently young and tender to receive the injury, yet old enough to survive it—a combination that might not often occur.

Mr. Wm. T. Davis exhibited specimens of dragon-flies and read the following:

Two Additions to the Local List of Dragon-flies.—The dragon-fly, *Libellula axillena* Westwood, form *vibrans*, was quite numerous last August in various parts of the island, both near ponds and in woodland. If persistently disturbed, they often flew into the highest trees. The first one was seen on August 4th in the valley of Reed's basket-willow swamp. In capturing it the abdomen was knocked off, and the remainder of the insect, true to what I afterward found to be the custom of the species, flew into a tree. Several missles induced it to change this perch for a less elevated one, and it was finally placed in the cyanide bottle. Previous to the summer of 1894, this dragon-fly had not been seen on the island, and it is an interesting fact that it eventually came in such numbers.

Two small specimens of *Diplax semicincta* Say, were taken on the 15th of last July at the small ponds of the old iron mines near Four Corners. This locality is also the only one on the island where *Nannothemis bella* Uhler has been found.

With these two additions, the species belonging to the sub-family *Libellulinæ*, so far collected on the island, number twenty-two. Mr. Calvert reports but twenty-four species from the vicinity of Philadelphia.

Minor Notes.—Mr. Arthur Hollick reported that an oppossum was captured on December 6th, at New Dorp, by Mr. Richard Britton. It was found in a shallow burrow in the ground, near the foundation walls of an old ruined house, and was easily unearthed. The animal was killed and has been sent to a taxidermist for mounting. From the appearance of the locality, Mr. Britton is of the opinion that a colony of the animals is living there.

Mr. Wm. T. Davis exhibited a small Indian stone paint pot, recently found at Tottenville. This is the first utensil of the kind reported from any of the collections made on the island.

Mr. Davis also exhibited a large yellow gravel pebble, consisting of a mass of silicified coral (probably an *Eridophylum*) found by Mr. Trigg on the shore at Eltingville.

March 9th, 1895.—Mr. Fred. F. Hunt read the following paper, illustrated by samples of the articles mentioned and tubes containing the tests made:

Arsenic in Wall Paper and Hangings.—Having had occasion lately to test some wall papers and hangings for arsenic, it may interest our members to know of the results obtained.

These tests were made on account of sickness, apparently a case of poisoning, which could not be traced to any cause. On finding that all the rooms in the house, except one, had arsenical wall paper, and also that some curtains and furniture covering carried arsenic, the doctor attributed the illness to that cause, and this view seems to have been borne out by the recovery of the patients on the removal of the arsenical materials.

The house is an old one, on this island, and some of the rooms had four papers on the walls. For testing, the papers were taken off to the plaster, and one test made of all the papers that were in one room together, so I am unable to say which carried the arsenic. The test used was the " Marsh test." All the rooms in the house that were papered, except one, and also the hallways, carried arsenic in larger or smaller quantities, some tests requiring the gas to be passed for ten minutes before showing the arsenic mirror, while others showed it after a few seconds, and one test gave the largest amount I have found in any wall paper.

It is generally supposed that a paper must have green in it to carry arsenic, but that is not so, as I have found it in nearly all colors; one ceiling paper, which has a ground of very light yellow with a gilt pattern on it, carried notable quantities of arsenic, while other papers that were different shades of green, carried none; in fact, my experience has been that the browns, reds, yellows and grays are the most likely colors to carry arsenic.

The cartridge papers do not carry arsenic, as far as my experience goes, even if there is a pattern printed on them. This may be due to its being a comparatively modern wall paper, and the manufacturers having found that of late years there has been more or less agitation on the subject of arsenic in wall papers, are more careful in the pigments they use.

A set of red-brown colored chenille curtains in this same house gave a very marked mirror of arsenic, although they had been in use for

some time in another house; a jute-velour furniture covering, color old rose, also gave the arsenical mirror, and a crêtonne of a black ground with light colored figures and pattern was highly charged with arsenic, even after several years' use as curtains, indicating that use does not eliminate the arsenic. Tests were made of 60 pieces of lately imported English crêtonnes, and only 20 pieces were found to be free of arsenic. In Germany and, of late years, in France, there are laboratories supported by the government, where anyone may take a substance believed to be injurious to health, to be tested free of charge, and, as there is a punishment for selling any such substance, fabrics from these countries are very likely to be free from deleterious matter.

There are two ways in which the arsenic may be disseminated in the air, first, by a chemical action forming arseniuretted hydrogen, which readily comes through any paper that may cover the arsenical one; second, a purely mechanical action, where the arsenical paper is outside, by the pigment or sizing, drying and being carried off as a powder and breathed—both these actions may be taking place with an arsenical outside paper.

SCIENTIFIC NEWS.

The Eighth Session of the Marine Biological Laboratory at Wood's Hole, Massachusetts, will last from June 1 to October 1, 1895. The laboratory is under the general charge of Prof. C. O. Whitman, Director, and Prof. H. C. Bumpus, Assistant Director.

Instruction will be given by the following staff: Howard Ayers, E. G. Conklin, S. Watasé, M. M. Metcalf, C. M. Child, F. R. Lillie, O. S. Strong, H. S. Brode, W. M. Rankin, J. L. Kellogg, P. A. Fish, A. D. Mead, H. E. Walter, W. A. Setchell, W. J. V. Osterhout, Jacques Loeb, W. N. Norman.

There will also be evening lectures on biological subjects of general interest. Among those who may contribute these lectures may be mentioned, in addition to the instructors above named, the following: G. F. Atkinson, E. G. Conklin, J. M. Coulter, A. E. Dolbear, Simon Flexner, E. O. Jordan, William Libbey, Jr.; F. S. Lee, W. A. Locy, J. M. Macfarlane, C. S. Minot, E. S. Morse, H. F. Osborn, W. B. Scott, W. T. Sedgwick, William Trelease, S. Watasé, E. B. Wilson, B. G. Wilder, W. P. Wilson.

The following courses of instruction are offered:

In the laboratory for teachers and students in anatomy which will be open from July 2 to August 30, two courses are offered: the first, in invertebrate anatomy, and the second, a newly arranged course in vertebrate anatomy. Either course may be made preparatory to the course in embryology. The course in invertebrate anatomy will embrace a study of the more typical marine invertebrates, instruction being given by lectures, laboratory work and collecting excursions. The lectures are given each morning, and by those who are specialists in the subject under consideration. For laboratory dissection, each student is supplied with fresh material, and the entire day is spent in study, under the direction of the instructors. Collecting excursions are taken on Wednesdays and Saturdays. The steam launch and boats are freely used, and methods of dredging, skimming, and general collecting are explained. The animals studied will be Grantia, Tubularia, Campanularia, Metridium, Mnemeopsis, Nereis, Phascolosoma, Polyzoa, Bdellura, Molgula, Branchipus, Lepas, Talorchestia, Cancer, Limulus, Asterias, Arbacia, Echinarachnius, Thyone, Venus, Sycotypus, Loligo.

The course in vertebrate anatomy has been arranged for those who desire a thorough study of the vertebrate body. Though primarily a laboratory course, under the direction of the officers of the laboratory, there will be daily lectures upon anatomy, physiology, and kindred subjects by the following lecturers: Professor H. P. Bowditch, Dr. F. S. Lee, Dr. C. F. Hodge, Dr. O. S. Strong, Dr. C. S. Minot, Dr. J. S. Kingsley, Dr. J. P. McMurrich, Dr. H. F. Osborn. The first week will be devoted to the Elasmobranchs, the Dogfish (*Galeus*) and Skate receiving special attention. The second week will be devoted to the higher Fishes. During the third week the Batrachia will be studied. The fourth week will be devoted to the Reptilia.

Instruction in microscopical technique will extend throughout the month. Methods of section-cutting, differential staining, etc., will be taught, and histological preparations of the more important tissues will be made.

The fee for either of the above courses is $40.00, payable in advance. It covers tuition, material for dissection, dissecting instruments, laboratory outlines, drawing paper and instruments, slides and covers, and a supply of glassware and reagents. The laboratory loans, without charge, microtomes and certain other apparatus; there is a small fee, however, for the use of microscopes, and all who can provide themselves with simple and compound microscopes before coming to Wood's Hole, are urged to do so.

Applications should be made, at the earliest convenient date to, Professor H. C. Bumpus (until June 1), Brown University, Providence, R. I.; June 1–September 1, Wood's Hole, Mass.

The laboratory work in botany will be restricted to the study of the structure and development of types of the various orders of the cryptogamous plants. Especial attention will be given to the study of the various species of marine Algæ, which occur so abundantly in the waters about Wood's Hole, and students desiring to give their entire attention to these plants will be encouraged to do so. The Fungi and higher Cryptogams will receive less attention than the Algæ, but will be studied in a few types. Lectures will accompany the laboratory work. The course may be outlined somewhat as follows:

First week: Cyanophyceæ—Lyngbya, Calothrix, Rivularia, Stigonema, Tolypothrix, Anabæna.

Second week: Chlorophyceæ—Spirogyra, Ulva, Enteromorpha, Chætomorpha, Bryopsis, Vaucheria, Œdogonium.

Phæophyceæ—Ectocarpus, Mesogloia, Leathesia, Laminaria, Fucus, Sargassum.

Third week: Rhodophyceæ—Batrachospermum, Nemalion, Callithamnion, Chondriopsis, Rhabdonia.

Fourth week: Phycomycetes—Mucor, Sporodinia, Peronospora, Cystopus, Achlya.

Uredinei—Æcidium, Uredo, Puccinia, Uromyces.

Fifth week: Basidiomycetes—Agaricus, Lycoperdon.

Ascomycetes—Microsphæra, Sordaria, Peziza, Physcia.

Sixth week: Muscineæ—Riccia, Madotheca, Marchantia, Mnium, Tetraphis, Hypnum.

Filicineæ—Dicksonia, Adiantum, Equisetum, Lycopodium, Marsilia, Selaginella.

The tuition for students in the regular course of laboratory work and lectures is $40.00, payable in advance; for students engaged in investigation the tuition is $50.00.

For the course in embryology, the introductory courses in anatomy, or their equivalent, are considered as prerequisites. The course is designed as a preparation for beginning investigation. The aim will therefore be, not only to master the details of development, but also to acquire a thorough knowledge of the method of preparing surface-views, imbedding in paraffin and celloidin, staining and mounting, drawing, reconstructing, modelling, etc. The study will be mainly confined to the fish egg as the best type for elucidating vertebrate development; but the eggs of amphibia and other vertebrates, as well

as some invertebrates, will receive attention. Each member of the class will be supplied with material, and be expected to work out the successive steps in development, beginning with the egg just after fertilization. The laboratory work will be conducted by Doctors Lillie and Strong, and accompanied with lectures and seminar work under the Director. The fee for this course is $50.00, and the class is limited to twelve.

Applicants should state what they have done in preparation for such a course, and whether they can bring a complete outfit, viz.: a compound microscope, a dissecting microscope, camera-lucida, microtome, etc. In case these instruments are furnished by the laboratory, an additional fee of $10 will be charged therefor. No application for less than the whole course will be granted.

For those prepared to begin original work, ten tables are reserved in zoology, and the same number in physiology and botany. The introductory and preparatory courses in each department, or an equivalent, are prerequisites for admission to these tables. Ability to read scientific German and French is also required. Special subjects for investigation are assigned to the occupants of tables, and the supervision of the work is so divided that each instructor has the care of but three or four students. In this way all the advantages of individual instruction are secured. All the lectures and the seminar are open to those engaged in such work. The fee is $50.

The forty private laboratories for investigators are distributed as follows:—Zoology, 22. Physiology, 8. Botany, 10.

These rooms are rented at $100 to colleges, societies or individuals.

The general laboratories are for the use of students engaged in special research under the supervision of the Director and his assistants, and for advanced courses preparatory to beginning investigation, such as the course in embryology. There are forty-two tables, of which zoology has twenty-two, physiology ten, and botany ten.

The seminar is especially designed for members of the class in embryology and beginners in investigation, but is open to all. It is expected that all who attend will be provided with the third volume of the Biological Lectures, as this will be made the basis of discussion. Most of the authors of these lectures will be present, and from two to three mornings will be devoted to the consideration of each lecture, and such questions as may be raised.

Wood's Hole is situated on the north shore of Vineyard Sound, at the entrance of Buzzard's Bay, and may be reached by the Old Colony Railroad (two and one-half hours from Boston), or by rail and boat

from Providence, Fall River, or New Bedford. Rooms accommodating two persons may be obtained near the laboratory at prices varying from \$1.00 to \$3.00 a week, and board from \$4.00 to \$6.00. Board will be supplied to members at The Homestead at \$5.00 a week.

The location of the Laboratory at Wood's Hole, gives it exceptional advantages for study and research. The shore is varied by necks, points, flats, gutters, holes, bays and islands; there are numerous fresh-water ponds and lakes in the vicinity; there is no muddy river or city sewerage to pollute the sea-water; the fauna and flora are exceptionally rich; the climate is especially favorable for summer work, and the place is free from the inconveniences and distractions of fashionable summer resorts.

The Laboratory consists of four two-story buildings, with forty private rooms for the exclusive use of investigators, and seven general laboratories. It is supplied with aquaria, collecting apparatus, reagents, glassware, and a limited number of microtomes and microscopes for use in the introductory courses. The investigators' rooms are furnished with glassware and reagents, but not with microscopes and microtomes. No alcohol is supplied beyond what is allowed for the work done in the laboratories; and expensive reagents, such as osmic acid and gold chloride, are not included in the list of free reagents. The laboratory has a steam launch, boats, dredges, and all the apparatus necessary for collecting and keeping alive material reserved for class work or research.

The library is provided with many works of reference and the more important journals of zoology and botany, some of them in complete series. Members of the Laboratory are allowed the use of books from the Library of the Boston Society of Natural History, through the courtesy of the Curator and the Librarian.

A department of laboratory supply has been established in order to facilitate the work of teachers and others at a distance, who desire to obtain material for study or for class instruction. Certain sponges, hydroids, star-fishes, sea-urchins, marine worms, crustaceans, mollusks, vertebrates and marine plants are generally kept in stock, though larger orders should be filed some time before the material is needed. Circulars giving information, prices, etc., may be obtained on application.

Bowdoin College Summer Courses in Science.—Beginning July 9, 1895, and continuing for five weeks, the following courses in science will be conducted by instructors in Bowdoin College at the

Searles Science Building, Brunswick, Maine.

(1) A course in Elementary Chemistry.

(2) A course in Advanced Chemistry.

(3) A course in Physics.

(4) A course in Biology.

These courses are designed especially for teachers, but are open to all earnest workers. It is believed that they will be well adapted to the needs of any student of natural science, giving, for example, an excellent introduction to the study of medicine or pharmacy. They will also be valuable to those who, either as teachers or scholars, are preparing to meet natural science requirements for admission to college. They will consist largely of practical work in the laboratory, and it is doubtful if any college laboratories in the country have superior facilities for this purpose.

Each elementary course will consist of lectures and laboratory work for two hours a day on five days of the week. No exercises will be held on Saturdays. Students in the advanced chemistry course can work in the laboratory as many hours a day as the instructor thinks advisable. A student in a single elementary course is not entitled to more than the regular time of work for that course, ten hours per week.

The fees for the courses, paid invariably in advance, are as follows:

For two or three elementary courses,	\$20.
For a single elementary course,	\$10.
For advanced chemistry,	\$15.

An extra charge will be made for chemicals used and apparatus injured in any course. Experience proves that such charge need not exceed three dollars.

Board and lodging can be obtained in Brunswick at a cost of from \$4 to \$6 per week.

Occasional evening lectures on scientific topics of a general nature may be expected from the different instructors.

The next Meeting of the American Microscopical Society will he held at Cornell University in Ithaca, N. Y., August 21, 22 and 23, 1895, that is, the week previous to the meeting of the American Association for the Advancement of Science, which is to be held in Springfield, Mass.

The unsurpassed beauty of the location of the University, and the richness of both its terrestrial and aquatic fauna and flora, make this an ideal place for holding the meeting. It is equally attractive to the

student of natural history and to those who love beautiful scenery. The facilities of the University and its equipment in all lines for carrying on microscopical work add to the attractiveness of Ithaca as a place of meeting.

The University buildings, which will be held at the disposal of the Society, are especially adapted for the formal presentation of papers, blackboard illustrations, hanging of diagrams, etc., as well as for any demonstration that authors may desire to make. The armory is very convieniently located both for the University and for the city, and a soiree there can hardly fail to be a great success.

Besides the attraction of papers and demonstrations by members, nearly all the opticians have expressed not only a willingness but a desire to be present and make an exhibit of their microscopes and microscopical apparatus, thereby affording the members an opportunity to see all the new and standard apparatus.

A special feature of the coming meeting will be the setting apart of one or more sessions for the reading of papers on methods and demonstration of special or new methods. The chairman of the local committee, Professor W. W. Rowlee, or the President, Prof. S. H. Page, will be glad to receive requests from those who desire to have some specially difficult method or structure elucidated, and an effort will be made to get some member particularly expert in such subject to demonstrate it before the Society.

Summer Zoological Laboratory of the Indiana University will be located at Vawter Park, the highest point on the southwestern shore of Lake Wawasee or Turkey in Kosciusko county. Wawasee is about nine miles long by three miles wide. In the immediate neighborhood are many lakes, some drained into Lake Michigan, others into the Wabash; a short distance to the east is the basin of Lake Erie and still a shorter distance to the west is the Illinois River basin. An hour's ride from the station over the moraine separating the Mississippi system from the St. Lawrence system will bring us to Webster, Tippecanoe and the Barber Lakes of the former system.

RESEARCH.—The main object of the station will be the study of variation. For this purpose a small lake will present a limited, well circumscribed locality, within which the differences of environmental influences will be reduced to a minimum. The study will consist in the determination of the extent of variation in the non-migratory vertebrates, the kind of variation whether continuous or discontinuous, the quantitative variation, and the direction of variation. In this way

it is hoped to survey a base line which can be utilized in studying the variation of the same species throughout their distribution. This study should be carried on for a series of years, or at least be repeated at definite intervals to determine the annual or periodic variation from the mean. A comparison of this variation in the same animals in other similarly limited and well circumscribed areas, and in the correlation of the variation of a number of species in these areas will demonstrate the influence of the changed environment, and will be a simple, inexpensive substitute for such expensive experimental work.

INSTRUCTION.—Courses of instruction which ordinarily cannot be given in the University's laboratories during the college year will be offered and credit given on the University's records. The courses are as follows:

1. *Elementary work.* The class will collect, preserve and study a series of animals occurring in the neighborhood of the station. Emphasis will be laid on the nature of the freshwater fauna and the correlation and adaption of organisms. The entire day will be given to collecting excursions, laboratory work and lectures. Individual work Saturdays. No special preparation is needed. (Teachers may collect material for their classes, but alcohol for this purpose will not be furnished).

2. *Embryology* and life history of fishes and other local forms.

3. *Special investigations* in the variation of non-migratory vertebrates and survey of the physical and biological conditions of Lake Wawasee.

Courses 1 and 2 will extend through five weeks beginning June 25th. Course 3 may extend at the pleasure of the investigator till the middle of September.

LECTURES.—A number of biologists will be present for a short time, several of whom have promised to lecture. Among those who will be present are: J. C. Arthur, Purdue University, Slime molds, the fungous-like animals; A. W. Bitting, Purdue University; E. P. Boyer, Chicago High Schools, Biology in the High Schools; R. E. Call, Louisville Manual Training High School, Freshwater molluscs; W. S. Blatchley, State Geologist, Insects and how to collect them; G. Baur, Chicago University, How to study Variation; J. M. Coulter, President Lake Forest University, (Subjects not yet announced); B. W. Evermann, U. S. Fish Commission, Field work of the U. S. Fish Commission; The Red Fish; P. Kirsch, Indiana State Fish Commissioner; L. J. Rettger, Indiana State Normal School, Some topic in physiology; Joseph Swain, President Indiana University, (Subject not yet announced).

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State Geological Survey of Kansas.—In conformity with the law under which the University of Kansas is now working, the Board of Regents at a recent meeting formally organized the University Geological Survey of Kansas with Chancellor F. H. Snow, ex-officio Director; Professor S. W. Williston, Paleontologist; Professor Erasmus Haworth, Geologist and Mineralogist; and Professor E. H. S. Bailey Chemist.

In addition to these, other members of the University Faculty, as well as the advanced students of the departments of Geology and Paleontology, will be engaged upon the work of the Survey. An effort will also be made to centralize and unify the energies of different geologists in the State who have been doing valuable work along different lines of geological investigations. Already a considerable start has been made and the co-operation of different geologists of the State has been secured.

Work in the Coal Measures of the State has been in progress for two summers, and Volume I of the Report is now almost ready for publication. Other volumes will appear at irregular intervals. Those already under preparation are: One on Coal, Oil and Gas; one on the Vertebrate Paleontology of the State; and one on the Salt and Gypsum deposits of Kansas.

The Summer Course of the University Extension Association will be held at the University of Pennsylvania in July, 1895, the course in Biology extending from July 1st to 26th. The lectures and laboratory courses will be conducted by L. H. Bailey (Cornell), E. D. Cope (Pennsylvania), G. L. Goodale (Harvard), B. D. Halsted (Rutgers), J. M. Macfarlane (Pennsylvania), J. S. Kingsley (Tufts), C. O. Whitman (Chicago), W. P. Wilson (Pennsylvania), L. L. W. Wilson (Philadelphia Normal School).

The Missouri State Horticultural Society will hold its Semi-Annual Meeting at the Opera House, Willow Springs, Mo., June 4, 5 and 6, 1895. The Kansas City, Ft. Scott and Memphis and Central Branch Railways will give a rate of half fare for round trip. The San Francisco and Missouri Pacific Railroads will give a rate of one and one-third fare on the certificate plan. Hotels will give rates of $1.00 per day and 75 cents per day.

The Colorado State Science Teachers' Association held its first meeting—since its organization in December last—in Denver, April 3d inst. The object of the association is to promote a better grade of instruction in the elementary schools and high schools of the State.

The Lehrbuch der praktischen vergleichenden Anatomie of Vogt and Yung is at last complete. It was begun in 1885.

The German Zoological Society will hold its annual meeting at Strasburg, June 4–8, 1895.

One boa in the zoological gardens of London recently swallowed another of his species which nearly equalled him in size.

Dr. Lewis R. Gibbes, of Charleston, S. C. died in that city, November 21, 1894. He was born there Aug. 14, 1810. In his early days he he was an ardent zoologist and the Proceedings of the Elliot Society (of which he was one of the founders) the American Association for the Advancement of Sciences and other journals formerly contained numerous systematic papers from his pen. Since the war he has left the zoological field, and has occupied the chair of mathematics and astronomy in the college of Charleston.

Dr. Bela Haller, well-known for his Molluscan studies, is now privatdocent at Heidelberg.

The bibliographical movement recorded in the columns of our January issue is making considerable progress towards its complete organization. The ultimate success of the undertaking now seems highly probable. In France, the organization has reached its greatest perfection and as an example of what is needed in America we may briefly describe what has been done by a number of zealous French zoologists. The annual meeting of the French Zoological Society held in February, 1894 had already discussed the matter in a preliminary way and had referred the decision to the Council of the Society. After mature consideration the Council of the Society designated one of its members, Prof. Bouvier, vice-president of the Society to study all the details of the project and to report upon them at a subsequent meeting. This report of M. Bouvier was presented in February last and was unanimously approved by the Council who ordered it to be presented before the Annual Reunion of February 28.

Basing its decisions upon this report as well as upon the recommendations of the Council, the Society nominated a permanent central *Commission de patronage et de propagande* comprising the following persons: —Prof. Blanchard, Prince Bonaparte, Prof. Delage, Prof. Filhol, Prof. Gandry, Baron de Guerne, Prof. Milne-Edwards, Prof. Raillet and Prof. Vaillant. As associate members twenty zoologists chosen to represent the various publishing centres of the country were nominated. It is through their agency that the central commission hopes to reach every part of France and to secure all the strictly zoological publications needed for the Bureau's work. Journals rarely containing zoological papers as well as any zoological journals or books which the Bureau

should be unable to obtain will be examined by a body of eleven special correspondents who have been secured for this purpose. They are distributed as follows. Prof. Bouvier, Botany, Chemistry, and Pharmacology; Prof. Baudouin, Anthropotomy, Physiology, Pathology, and Medicine; Prof. Hervé, Anthropology; Prof. Lignières, Veterinary Science; M. Roché, Chief Inspector of Fisheries, Pisciculture; M. Caustier, Sec. Soc. Acclimatization; M. Boule, Asst. in the Nat. Hist. Museum, Vertebrate Palæontology, M. Haug, Instructor in the Faculty of Science, Invertebrate Palæontology; M. Denicker, Chief Librarian of the Nat. Hist. Museum, Separate Books and certain journals accessible in the Nat. Hist. Library; M. Léveillé, Librarian of the Entomological Society, Books and Journals accessible in the Entomological Library; M. Richard, Sec. Zool. Soc., Journals accessible in the Zoological Society's library or in that of this Philomathic Society and the Society ordered; M. Bouvier's report to be printed and distributed at once.

A preliminary inquiry among a number of learned societies and the leading publishing firms of Paris seems to indicate that almost all the journals as well as the separate works of interest for the Bureau will be sent to it gratuitously. Publishers and learned societies alike can only profit by having their publications made known promptly to those persons who would wish to use them. *Not a single failure to accept the invitation to co-operate has thus far been encountered.*

In Russia also a distinct advance has been made in the last two months; but the conditions are here too different to serve as a model for what we hope may soon be accomplished in America.

The Third International Zoological Congress will meet at Leyden, Holland, September 16–21, 1895. The Netherlands' Zoological Society has taken upon itself the task of making all the arrangements for the meeting. Their Excellencies, the Minister of the Interior, and of the Public Works, of Commerce and Industry, will be the Honorary Presidents of the Congress; Dr. P. P. C. Hoek (Helder), General Secretary, and Dr. R. Horst (Leyden) Treasurer. The following scheme for the Sectional Meetings has been adopted: 1*st section,* General Zoology, Geographical Distribution, including fossil faunas; The Theory of Evolution.—2*d Section,* Classification of Living and Extinct Vertebrates, Bionomy, Geographical Distribution, including Fossil Vertebrates.—3*d Section,* Comparative Anatomy of Living and Extinct Vertebrates; Embryology.—4*th Section,* Classification of Living and Extinct Invertebrate Animals; Bionomy.—5*th Section,* Entomology. 6*th Section,* Comparative Anatomy and Embryology of Invertebrate Animals.

The circular of announcement for the meeting has been signed by 310 Zoologists.